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THE

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TO CORRESPONDENTS.

It is hoped that the present Number contains satifactory answers to the numerous questions that have been put to us, respecting *Oxygenated Water*.

If J. T———s will favour us with his address, the Paper shall be printed; otherwise we cannot answer for its accuracy.

Z. on Electricity must return a *positive* answer to the Questions of A., before we can admit his conclusions.

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Royal Institution, Dec. 1819.

The following Lectures will be delivered in the Amphitheatre of the Royal Institution, during the ensuing season:

On Poetry, by Thomas Campbell, Esq.

On Architecture, by John Soane, Esq., R.A.

On the History of Chemical Science, by W. T. Brande, Esq., Prof. Chem. R. I.

On Experimental Philosophy, by J. Millington, Esq., Prof. Mech. R. I.

On Botany, by Sir J. E. Smith, Prof. Botany, R. I.

TO CORRESPONDENTS.

We entreat our Correspondent at Rotheram, to search for the spirit of the Foreign Scientific Journals in the *Miscellanea*. They are carefully perused, and such extracts made as appear worth preserving.

We are obliged by a Letter, signed W.B., and will endeavour to profit by the suggestions therein contained.

Concerning the extension and diminution of Copper-plate Engravings, we cannot offer any thing satisfactory. The Letter, therefore, signed J. G. H. remains as the writer has requested.

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THE
QUARTERLY JOURNAL,
October, 1819.

ART. I. *A Tribute to the Memory of the late President of the Literary and Philosophical Society of Manchester. By* William Henry, M.D., F.R.S., *&c. &c.*

[This account of the life of the late Mr. WILLIAM HENRY was read to the Literary Society of Manchester, in April 1817.]

THE following Tribute to the memory of the late President of the Literary and Philosophical Society of Manchester has been drawn up in compliance with a request, expressed to the writer from the chair, at an early meeting during the present session. It would, on some accounts, have been more satisfactory to him, that the office should have fallen into other hands. But, conceiving a compliance with the requisition to be a duty, which he was not at liberty to decline, he has endeavoured to execute it with all the impartiality and fidelity in his power; and he trusts to the candour of the Society for that share of indulgence, which he may reasonably claim, in speaking of one to whom he was so nearly allied.

THE late Mr. Henry was descended from a respectable family, which for several generations, had resided in the county of Antrim. His paternal grandfather commanded a company of foot in the service of James the Second; and during the disturbed times, which, in Ireland, succeeded the revolution, was shot by an assassin in his own garden. The father of Mr. Henry, then an infant scarcely a year old, was taken under the generous protection of a neighbouring nobleman*, who continued it to him during the remainder of his life; and, after being educated in Dublin at his lordship's expense, was brought

* Viscount Bulkley.

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over by him into Wales, when he had nearly attained the age of manhood. Having there, a few years afterwards, married the daughter of a respectable clergyman of the establishment, they sought the means of support by jointly engaging in the education of females, and for many years conducted a respectable boarding-school, first at Wrexham in North Wales, and afterwards in Manchester.

It was at the former place that Mr. Henry was born, on the 26th of October, O. S. in the year 1734. For some years he remained under the tuition of his mother, who was admirably fitted for the task, and of whom he was always accustomed to speak with the warmest affection and gratitude. At a proper age, he was sent to the Grammar school of Wrexham, at that time in considerable repute. There he was fortunate in having for his first classical instructor, the Rev. Mr. Lewis, whose virtues and talents are the subject of an elegant Latin epitaph, copied by Mr. Pennant into his *Tour through Wales**. At this school Mr. Henry remained for several years, and made such proficiency in his classical studies as to have attained the foremost station, with the exception only of Mr. Price, who was afterwards well known as the keeper of the Bodleian Library in the University of Oxford.

The inclination of Mr. Henry, from early life, led him to the church; and it was determined that, on leaving school, he should remove to Oxford. The day of his departure was accordingly fixed, and a horse was provided for the journey. But as the time drew near, his parents, who had a numerous family, and were far from being in affluent circumstances, grew discouraged at the prospect of expenses that were unavoidable, and at the uncertainty of eventual success. While they were thus hesitating, Mr. Jones, an eminent apothecary of Wrexham, decided the point, by proposing to take Mr. Henry as an apprentice; and to this measure, though deeply feeling the disappointment of long indulged hopes, he could not deny the reasonableness of assenting. With Mr. Jones he continued, till that gentleman died suddenly from an attack of gout, when he

* Page 293.

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was articled, for the remainder of the term, to a respectable apothecary at Knutsford in Cheshire.

In neither of these situations did Mr. Henry enjoy any extraordinary opportunities of improvement. The only book which he remembered to have been put into his hands, by either of his masters, was the Latin edition of *Boerhaave's Chemistry*, in two volumes quarto, a work which, whatever may have been its merits, was certainly not calculated to present that science to a beginner under a fascinating aspect. His reading was, therefore, entirely self-directed; and, by means of such books as chance threw into his way, he acquired a share of knowledge, creditable both to his abilities and his industry.

At the expiration of his apprenticeship, he engaged himself as principal assistant to Mr. Malbon, who then took the lead as an apothecary at Oxford. In this situation, he was treated by Mr. Malbon with the indulgence and confidence of a friend; and his time was chiefly spent in visiting patients of the higher class, a majority of whom were members of the University. Among the students at Oxford, were several who recognised Mr. Henry as a former associate, and who, though holding the rank of gentlemen-commoners, renewed their acquaintance with him, and afforded him the most friendly countenance. His leisure hours were, therefore, spent most agreeably and profitably in the different colleges; and his taste for literary pursuits was encouraged and confirmed. At Oxford he had an opportunity of attending a course of anatomical lectures, in which the celebrated John Hunter, then a young man, was employed as a demonstrator.

From Mr. Malbon, who was become affluent, Mr. Henry received a strong mark of esteem and confidence in the offer of a future partnership. To have accepted this it would have been necessary that he should have qualified himself to matriculate, which would have required the completion of a residence of seven years. But other views in life, which were inconsistent with so long a season of expectation, induced him to decline the proposal; and, in the year 1759, he settled at Knutsford, where he soon afterwards married. After remaining five years at this place, he embraced the opportunity of succeeding to the business

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of a respectable apothecary in Manchester; where he continued, for nearly half a century, to be employed in medical attendance for the most part on the more opulent inhabitants of the town and neighbourhood.

Soon after Mr. Henry's settlement in Manchester, the late Dr. Percival removed to the same town from Warrington. That eminent physician was early inspired with the same ardent zeal for the cultivation of professional and general knowledge, which afterwards so much distinguished him. Between Dr. Percival and the subject of this memoir, congeniality of taste and pursuits led to a frequent intercourse; and the moral qualities of both cemented their connexion into a friendship which continued, without interruption, until it was terminated by the death of Dr. Percival, in 1804. It was about the same early period, that he formed an acquaintance with that excellent man, and upright magistrate, the late Mr. Bayley, of Hope-Hall, and much of the happiness of his future life was owing to the mutual esteem and confidence, and to the frequent intercourse, which continued to exist between them for more than thirty years*.

During his apprenticeship, Mr. Henry had manifested a decided taste for chemical pursuits, and had availed himself of all the means in his power, limited as indeed they were, to become experimentally acquainted with that science. This taste he continued to indulge after his settlement in life; and, after having made himself sufficiently master of what was ascertained in that department of knowledge, he felt an ambition to extend its boundaries. In the year 1771, he communicated to the Royal College of Physicians of London, "*An Improved Method of Preparing Magnesia Alba*," which was published in the second volume of their Transactions. Two years afterwards it was reprinted, along with essays on other subjects, in a separate volume, which was dedicated by Mr. Henry to his friend Dr. Percival.

The calcination of magnesia had, at that time, been practised

* An interesting biographical sketch of Mr. Bayley, written by Dr. Percival, appeared in one of the volumes of the *Monthly Magazine* for the year 1802.

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only in connexion with philosophical inquiries. Dr. Black, in an essay which is still, perhaps, not surpassed in chemical philosophy as an example of inductive investigation, had fully established the differences between magnesia in its common and in its calcined state; but he does not appear to have made trial of the pure earth as a medicine, though several inconveniences from its use in the common form, had long before been pointed out by Hoffman*. On this subject Mr. Henry's claims extend to the free disclosure of his improvements; to the early and strenuous recommendation of the medicinal use of pure magnesia; and to the discovery of some of its chemical agencies. It is but justice to him to state that his recommendation of its employment as a medicine was perfectly disinterested; for it was not till his work was printed, and on the eve of issuing from the press, that the preparation of magnesia for sale was suggested to him by a friend, in a letter relating to the intended publication, which is still preserved as a part of his correspondence. Before carrying this suggestion into effect, he thought it proper to consult Sir John Pringle, Sir Clifton Wintringham, Dr. Warren, and some other leading members of the College of Physicians, as to their opinion of the propriety of the measure; and he did not adopt it until those gentlemen had each declared it to be not more advisable on his own account, than on that of the public.

Soon after the publication of the small volume of essays, Mr. Henry found himself involved in a controversy, arising out of some remarks in the appendix, respecting which, as the subject was of temporary interest, it is unnecessary to enter into particulars. It is sufficient to state that the accuracy of some of his experiments, which had been called in question, was confirmed by the concurrent testimony of Dr. Percival and Dr. Aikin; and that the chemical properties, first ascertained by him to belong to pure magnesia, were considered, by Bergman and by Macquer, as worthy of being incorporated into their respective histories of that earth.

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* Hoffman. Oper Tom. 4. p. 381.

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It was probably in consequence of the publication of these inquiries, that Mr. Henry was admitted into the Royal Society of London, of which he became a Fellow in May 1775. The persons most active in promoting his election, were Sir John Pringle and Dr. Priestley; and he had the advantage not only of the vote, but of the favourable influence of Dr. Franklin, who happened at that time to be in London. Several years afterwards, the same venerable philosopher, when in the 81st year of his age, presided at the meeting of the American Philosophical Society, at which Mr. Henry was elected a member, and again honoured him with his suffrage*.

The writings of the celebrated Lavoisier were introduced by Mr. Henry to the notice of the English reader in 1776. The earliest work of that philosopher was a volume, consisting partly of an historical view of the progress of pneumatic chemistry from the time of Van Helmont downwards; and partly of a series of original essays, which are valuable as containing the germs of his future discoveries. To this work, Mr. Henry added, in the notes, occasional views of the labours of contemporary English chemists. A few years afterwards he translated, and collected into a small volume, a series of Memoirs, communicated by M. Lavoisier to the Paris Academy of Sciences, when the views of that philosopher, respecting the anti-phlogistic theory of chemistry, were more fully unfolded. In undertaking the translation of these works, he was influenced by a desire to place within the reach of English readers, among whom the knowledge of the French language was then confined to comparatively few, the pleasure and conviction which he had himself derived from these beautiful models of philosophical inquiry.

Notwithstanding the large share of professional employment to which Mr. Henry had now attained, he still continued to engage frequently in experimental pursuits, the results of which, at this time, were communicated to the world, chiefly through

* This circumstance is stated in a letter from Dr. Rush to Mr. Henry, dated Philadelphia, 29th July, 1786.

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the publications of his friends Dr. Priestley and Dr. Percival. Of these, the most important were some Experiments on the Influence of Fixed air on Vegetation, by which he endeavoured to shew that though fixed air is injurious, when unmixed, to the vegetation of plants, yet that when mingled in small proportion with common air, it is favourable to their growth and vigour. The facts established by this inquiry, were communicated to Dr. Priestley; and it is creditable to the candour of that distinguished philosopher, that he was anxious to make them public, not only for their general merit, but because in one or two points the results disagreed with his own. "I am much pleased," Dr. Priestly replies, "with the experiments mentioned in your letter, and if you have no objection, shall be glad to insert the greatest part of it in my Appendix, which I am just sending to the printer's. I the rather wish it, as a few of the experiments terminate differently from those that I shall publish, and I wish to produce all the evidence I can come at on both sides. The other experiments are very curious and will give much satisfaction*." The investigation was afterwards resumed by Mr. Henry, and made the subject of a paper, which is printed in the second volume of the Memoirs of this Society.

The occasion of Mr. Henry's next appearance, as the author of a separate work, arose out of an accidental circumstance. He had found that the water of a large still tub was preserved sweet for several months by impregnating it with lime, though, without this precaution, it soon became extremely putrid. This fact suggested to him an eligible method of preserving water at sea†; but as lime water is unfit for almost every culinary purpose, some simple and practicable method was required of separating that earth from the water, before being applied to use. This he ascertained might be accomplished at little expence by carbonic acid, the gas from a pound of chalk and 12

* Letter from Dr. Priestley to Mr. Henry, dated Jan. 5, 1777.

† Dr. Alston of Edinburgh appears, however, to have been the first who proposed impregnation with lime, as a mean of preventing the putrefaction of water; and to precipitate the lime, he suggested the use of carbonate of magnesia.

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ounces of oil of vitriol being found sufficient for the decomposition of 120 gallons of lime water*. The only difficulty was in the mode of applying the gas on a large scale; but this was overcome by the contrivance of an apparatus, which Mr. Henry described in a pamphlet dedicated to the Lords of the Admiralty. The proposal, in consequence of the zealous personal exertions of Mr. Wedgwood, who was then in London, met with due attention from the Commissioners for victualling His Majesty's ships. The chief obstacle to its adoption in the Navy was an apprehension, probably well grounded, that persons would scarcely be found on ship-board, possessing sufficient skill for conducting the process successfully. Since that time, the preservation of water at sea has been accomplished by the simple expedient of stowing it in vessels constructed or lined with some substance, which is not capable of impregnating water with any putrescible ingredient; for good spring water, it is well known, contains essentially nothing that disposes it to putrefaction.

The philosophical pursuits of Mr. Henry, not long after this period, received an additional stimulus by the establishment of the Society to which these pages are addressed, and by his anxious desire to fulfil his duties as a member of it. To him, on its being first regularly organized in the winter of 1781, was confided the office of one of the Secretaries. At a subsequent period, he was advanced to the station of Vice-President, and in the year 1807, on the vacancy occasioned by the death of the Rev. George Walker, F. R. S., he received from the Society, and retained during the rest of his life, the highest dignity which it has to bestow.

The "*Memoirs of Albert de Haller*," which were published by Mr. Henry in 1783, and dedicated to this Society, were derived partly from a French *Eloge*, and partly from information communicated by the late Dr. Foart Simmons. A more complete view

* The water, however, for which these proportions were sufficient, could not have been completely charged with lime, for fully saturated lime-water would have required for decomposition nearly three times that quantity of chalk and oil of vitriol.

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of the life and acquirements of that extraordinary man might have been collected, at a subsequent period, from other publications of the same kind, which were addressed to different learned societies on the continent. In one respect, Mr. Henry appears to have taken too favourable a view of the character of Haller, in ascribing to him gentleness of disposition; for that illustrious, and, in the main, excellent person, seems to have been a man of quick passions, and not sufficiently reserved in the expression of them; as may be gathered from his controversy with Dr. Whytt of Edinburgh. Haller is represented, also, by his biographer, as afflicted with the personal defect of weak eyes; which, from a passage in his Physiology *, appears not to have been correct. "Aquæ puræ," he says, "qua ab anno ætatis 18 sola utor, tribuo, quod post tot in fulgido sole susceptos microscopicos labores, omnibus sensibus, *et oculis potissimum*, non minus valeam, quam puer valui."

During the long season of Mr. Henry's activity as a member of this Institution, his communications to it were very frequent. Many of these were intended only to excite an evening's discussion, and having served that purpose were withdrawn by their author, but the number is still considerable, which are preserved in the Society's published volumes. As might be expected, they are of various degrees of merit, but there are among them two papers, which have contributed greatly to his reputation as a chemical philosopher †.

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* Tom. vi. p. 240. Edit. 2. Lausannæ.

† The following is a list of Mr. Henry's Papers, that are dispersed through the printed Memoirs of this Society:

In Vol. I. (1.) An Essay on the Advantages of Literature and Philosophy in general, and especially on the Consistency of Literary and Philosophical with Commercial Pursuits.

(2.) On the Preservation of Sea Water from Putrefaction, by means of Quicklime.

(3.) On the Natural History and Origin of Magnesian Earth, particularly as connected with those of Sea Salt and Nitre, with Observations on some Chemical Properties of that Earth, which have been hitherto unknown or undetermined.

In Vol. II. (1.) Experiments on Ferments and Fermentation, by which a

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The Essay on Ferments and Fermentation is valuable, not for the theoretical speculations which it contains, for these have been superseded by subsequent discoveries; but for a few facts of considerable importance. It was at that time believed that the infusion of malt, called *wort*, could not be made to ferment, without the addition of yeast, or barm; but Mr. Henry discovered that wort may be brought into a state of fermentation, by being impregnated with carbonic acid gas. By a fermentation thus excited, he obtained not only good beer, but yeast fit for the making of bread; and, from separate portions of the fermented liquor, he procured also ardent spirit and vinegar, thus proving that the fermentative process had been fully completed. He found, moreover, that flour and water, boiled to the consistence of a thin jelly, and impregnated with carbonic acid in a Nooth's machine, passed into fermentation, and by the third day had assumed the appearance of yeast, for which it served as a tolerable substitute in the baking of bread.

The other memoir, which is distinguished by its value and importance, is entitled, "Considerations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dyeing; on the various Preparations and Mordants requisite for these different

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Mode of exciting Fermentation in Malt Liquors, without the aid of Yeast, is pointed out; with an attempt to form a new Theory of that Process.

(2.) Observations on the Influence of Fixed Air on Vegetation, and on the probable Cause of the Difference in the Results of various Experiments made for that purpose.

In Vol. III. Observations on the Bills of Mortality for the Towns of Manchester and Salford.

(2.) Case of a Person becoming short-sighted in Advanced Age.

(3.) Considerations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dyeing; on the various Preparations and Mordants requisite for these different substances; and on the Nature and Properties of Colouring Matter—Together with some observations on the Theory of Dyeing in general, and particularly the Turkey-Red.

New Series, Vol. II. Remarks on Mr. Nicholson's Account of the Effects produced at Swinton by a stroke of Lightning.

And a Paper, printed in this volume, entitled, Memoirs of the late Charles White, Esq. F.R.S., chiefly with a Reference to his Professional Life and Writings.

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Substances; and on the Nature and Properties of Colouring Matter."

After having given a general view of the history of the art of Dyeing, Mr. Henry, in this elaborate essay, examines the theories that had been framed to account for the various facility and permanency with which different substances attract colouring matter. He demonstrates the futility of those hypotheses, that explained the facts by supposed peculiarities of mechanical structure in the materials to be dyed; and suggests the probability, that the unequal powers of absorbing and fixing colouring matter, manifested by wool, silk, linen, and cotton, depend on the different attractions inherent in those substances as chemical compounds, for the various colouring ingredients. All the preparatory operations, though differing for each material, have, he apprehends, one common object, *viz.*, the removal of some extraneous matter, which, being already united with the substance to be dyed, prevents it from exerting its attraction for colouring matter. The ultimate object of these preliminary steps, he states to be the obtaining a white ground, that may enable the colours to display the full brilliancy of their several tints. To explain the preparation of cotton for the Turkey-red dye, he endeavours to prove that cotton requires, for this purpose, to be approximated, in composition, to the nature of an animal substance. He next offers a classification of the *Materia Tinctoria*, and some general speculations on the nature of colouring matter.

In the second part of the Essay, Mr. Henry investigates the mode of action of those substances which, though themselves destitute of colour, are important agents in the processes of dyeing. Substances of this kind had received, from the French dyers, the name of *Mordants*, because it was imagined that they corroded and removed something, which mechanically opposed the entrance of the colouring matter into the pores of the material to be dyed. To destroy this erroneous association, Mr. Henry proposes that the word *basis* should be substituted, as a general term, to denote every substance, which, having an affinity both for the colouring matter, and for the material to be dyed, is capable of serving as an intermedium between the two; and that

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a specific epithet should be added, to distinguish each particular variety. In this essay Mr. Henry, for the first time, explained the true nature of the liquor which is employed for affording the aluminous basis, prepared by mixing the solutions of alum and of sugar of lead. This liquor he shewed to be essentially a compound of pure clay or alumine with acetic acid; and its superiority over a solution of common alum, for yielding the earthy base in dyeing, he ascribes partly to the less affinity of the acetic acid, than of the sulphuric, for alumine, and partly to the greater volatility of the acetic acid, when exposed to a moderate increase of temperature. The remainder of the paper is chiefly occupied with the details of the operations then practised for dyeing Turkey red; with a theory of the process, and with a general view of the mode of action of the individual mordants or bases. The methods of dyeing Turkey red have been since much improved and simplified, though its theory is, even yet, far from being well understood. But the opinions inculcated by Mr. Henry respecting the action of mordants, evince a remarkable superiority to the prejudices with which he found the subject encumbered, and are indeed those which are still held by the latest and best writers on the principles and practice of dyeing.

In the year 1783, an institution arose out of this society, which had great merit, not only in its plan and objects, but in the ability exerted by the several persons, who were concerned in their fulfilment. It was destined to occupy, in a rational and instructive manner, the evening leisure of young men, whose time, during the day, was devoted to commercial employments. For this purpose, regular courses of lectures were delivered on the belles lettres, on moral philosophy, on anatomy and physiology, and on natural philosophy and chemistry. Mr. Henry, assisted by a son, whose loss he had afterwards to deplore, and whose promising talents and attainments obtained for him, at an early period of life, a mark of the approbation of this Society*,

* See Dr. Percival's eloquent address to Mr. Thomas Henry, junior, on presenting to him the silver medal of the Society.—*Memoirs of the Society*, Vol. II. page 513.

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delivered several courses of lectures on chemistry to numerous and attentive audiences. From causes, which it is not easy to trace, but among which, I believe, may be reckoned a superstitious dread of the tendency of science to unfit young men for the ordinary details of business, this excellent institution fell into decay. Mr. Henry, however, continued his lectures long after its decline, until deprived of the services of his son, by the prosecution of views at a distance, when he found that his own leisure was not, of itself, adequate to the necessary preparations.

That the scheme of establishing in Manchester a College of Arts and Sciences (for so it was entitled,) was not a visionary project, but one which appeared feasible and promising to men of sense and knowledge at a distance, is shewn by the following extracts from letters addressed to Mr. Henry, in reply to his communication of the plan. "An attempt of this kind," the late Dr. Currie of Liverpool observes, "I think most praiseworthy; and for this, however the matter may terminate, the projectors will always be entitled to public favour and esteem. It is a bold enterprise, and of course in some degree doubtful. One thing appears to me probable;—that if the business is taken up as it ought to be by the public, you will soon find the propriety of extending your plan, so as to make it embrace every object of general education." Mr. Wedgwood also strongly expressed his approbation of the undertaking. "The plan of your college," he says, "I think an excellent one, and from the populous and commercial state of your town—from the apparent utility of the Institution—from the elegance and propriety with which it is announced—and from the known characters of the gentlemen who are engaged in it, I can scarcely entertain a doubt of its meeting with success." Greater perseverance would perhaps have gradually softened, and finally subdued, the prejudices that seem to have existed against the union of commercial with literary or philosophical pursuits,—an union which, under proper regulation, adorns and dignifies the character of the merchant, without, it may be hoped, diminishing his usefulness, or interfering with the prosperous management of his affairs.

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Besides the lectures on the general principles of chemistry, Mr. Henry delivered a course on the arts of bleaching, dyeing, and calico-printing; and to render this course more extensively useful, the terms of access to it were made easy to the superior class of operative artisans. It was at this period, that the practical application was made in France of a philosophical discovery to one of the arts which Mr. Henry was engaged in teaching, that shortened, by several weeks, the duration of its processes. In 1774, Scheele, a Swedish chemist, distinguished by the number and great importance of his contributions to chemical science, discovered, in the course of some experiments on manganese, the substance known successively by the names of dephlogisticated marine acid, oxy-muriatic acid, and chlorine. During several years afterwards, its properties were not applied to any practical use, until its power of discharging vegetable colours suggested to M. Berthollet, of Paris, its employment in the art of bleaching. The first successful experiments with that view were made by M. Berthollet in the year 1786, and, with a liberality which confers the highest honour upon him, he freely communicated his important results, not only to his philosophical friends, but to those who were likely to be benefited by them in practice. Among the former was Mr. Watt of Birmingham, who happened at that time to be in Paris, and who was the first person in this country to carry the discovery into effect, by bleaching several hundred pieces of linen by the new process, at the works of a relative near Glasgow. Mr. Henry also, having received an indistinct account of the new method, but not knowing precisely in what it consisted, immediately set about investigating the steps of the operation; and in this he was fortunate enough to succeed. Soon afterwards, an attempt was made by some foreigners, who themselves had acquired their information from Berthollet, to turn the process to their own advantage, by obtaining a patent; and having failed in that, by applying for a parliamentary grant of an exclusive privilege of using it for a certain number of years. Against the former, a strong memorial, (which is now before the writer,) was presented by Mr. Henry to the Attorney and Solicitor-General; and effectual

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opposition was made to the latter, by a public meeting of the inhabitants of Manchester, on the ground that the whole process had been successfully carried into effect by Mr. Watt, Mr. Henry, and Mr. Cooper*.

Having satisfied himself of the practicability and advantages of the new method of bleaching, by carrying it on upon a scale of sufficient extent, Mr. Henry prepared to embark in a much larger establishment for the purpose. The connexion, however, which he entered into with this view, having disappointed his just expectations, and the further prosecution of it being inconsistent with his professional employments, he abandoned the project, and contented himself with imparting the knowledge he had gained to several persons, who were already extensively engaged in the practice of bleaching, by the then established methods.

Mr. Henry had now reached a period of life, when the vigour of the bodily powers, and the activity of the mind, begin, in most persons, to manifest a sensible decay. From this time, however, though he did not embark in new experimental inquiries, yet he continued for many years to feel a warm interest in the advancement of science, and to maintain an occasional correspondence with persons highly eminent for their rank as philosophers, both in this and other countries†. His medical occupations had greatly increased, and, for a further interval of fifteen or twenty years, he had a share of professional employment, which falls to the lot of very few. This, and the super-

* The reader, who is interested in the history of the introduction of chlorine and its compounds into use in bleaching, is referred to a note in Dr. Brewster's *Edinburgh Encyclopedia*, Art. BLEACHING; and to Dr. Thomson's *Annals of Philosophy*, Vols. 6 and 7.

† A considerable collection of letters to Mr. Henry from persons of this description has been preserved; but the subjects of them have, for the most part, been long ago brought before the public by their respective writers. The letters are chiefly valuable to the family of the deceased, as unequivocal proofs of the respect and esteem felt towards him, by those who were best qualified to judge of his merits. Many of them are from learned foreigners, with whom he had enjoyed opportunities of personal intercourse during their visits to Manchester.

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intendence of some chemical concerns, prevented him from attempting more than to keep pace with the progress of knowledge. He was in no haste, however, to claim that exemption from active labour, to which advanced age is fairly entitled, and it was not till a very few years before his death, that he retired from the exercise of the medical profession.

The summers of the years 1814 and 1815 were spent by Mr. Henry in the country, a mode of life, which, now that his season of active exertion was passed, was peculiarly suited to him, not only by the tranquil retirement which it afforded, but by its enabling him to indulge that sensibility to the charms of rural scenery, which can, perhaps, only exist in a pure and virtuous mind. His perception of these pleasures was at no period more lively, than after he had entered his 81st year. In a note, addressed to the writer of these pages, in the autumn of 1815, he describes, in animated language, one of those events, which so agreeably diversify the face of nature in the country. "Yesterday," he says, "we had one of the most beautiful appearances in the garden I ever witnessed. Every leaf—every petal—every projecting fibre—was beset with a minute globule of water, and when the sun shone upon the flowers and shrubs, they seemed as if studded with myriads of brilliants. The gossamer, too, with which the hedges were covered, was adorned with the same splendent appendages. The cause," he adds, "of this deposition of moisture must, I suppose, have been electrical."

The winter of the year 1815, which Mr. Henry passed in Manchester, was a season of greater suffering than was usual to him; for though of a delicate constitution, yet he happily, even at this advanced time of life, enjoyed an almost entire exemption from painful diseases. During this winter, he was much distressed by cough and difficult breathing, and his bodily strength rapidly declined. In the spring of the following year, he returned into the country, but not to the enjoyments which he had before derived from it. He was unable to take his customary walks, and was oppressed by feelings, which induced him to look forwards to the close of life, with the certainty of its near approach, but with calm and dignified resignation. The event,

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which he had anticipated, took place on the 18th of June, 1816, when he had nearly completed his 82d year.

In estimating the intellectual character and attainments of the subject of this memoir, it is proper to revert to a period, several years remote from the present, but still within the perfect recollection of many to whom these pages are addressed. At that time, the quality of Mr. Henry's mind which was, perhaps, most conspicuous, was a readiness of apprehension, that enabled him to acquire knowledge with remarkable facility. To this was joined a quickness in his habits of association, that peculiarly fitted him to perceive those analogies which, in chemical investigations, were chiefly relied upon as leading to the discovery of truth, before it was sought to be established on the firmer basis of an accurate determination of quantities and proportions. Without claiming for Mr. Henry the praise of great original genius, we may safely assert for him a very considerable share of that inventive talent, which is commonly distinguished by the term *ingenuity*. This was especially displayed in the neatness and success with which he adapted to the purposes of experiment, the simple implements that chance threw in his way; for it may be proper to observe that, at no period of his life, was he in possession of a well-furnished laboratory, or of nice and delicate instruments of analysis or research. With these qualifications, he united a degree of ardour in his pursuits, which enabled him to triumph over obstacles of no trivial amount. And when it is considered that his investigations were carried on, not with the advantages of leisure, ease, and retirement, but amidst constant interruptions, and with a mind harassed by frequent and painful anxieties,—it will be granted, that he accomplished much more than might have been expected, from one so little favoured by external circumstances.

The acquirements of Mr. Henry were not limited to that science in which he obtained distinction. It was the habit of his mind, when wearied by one occupation, to seek relief, not in indolent repose, but in a change of objects. In medical know-

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ledge, he kept pace with the improvements of his time, and he occasionally by original publications*, contributed to its advancement. He had a share of general information, and a flow of animal spirits, that rendered him an instructive and agreeable companion. To the rich sources of enjoyment, which are opened by the productions of the fine arts, he was extremely sensible, not so much from an acquaintance with critical rules, as from a natural and lively susceptibility of those emotions, which it is the object of the poet and the artist to excite. By the native strength of his memory, unassisted by any artificial arrangement, he had acquired a knowledge of history, remarkable for its extent and precision; he was always eager to discuss those questions of general policy, which are to be decided, partly by an appeal to historical evidence, and partly by a consideration of the nature of man, and of his claims and duties as a member of society. No representation of him would, indeed, be complete, that failed to notice the animation with which he entered into arguments of this kind, or the zeal and constancy with which he defended his political opinions,—opinions which, in him, were perfectly disinterested and sincere, but which perhaps disposed him to allow more than its due weight to the aristocratical part of our mixed government. It would be unjust to him, however, not to state, that no man could more cordially disapprove, or more unreservedly condemn, every undue exertion of power; or could more fervently desire the extension of the blessings of temperate freedom to all mankind. It was this feeling that led him to use his strenuous exertions as a member of one of the earliest Societies for procuring the abolition of the African Slave Trade; and when that great object was at length accomplished, he was affected with the most lively joy and gratitude on the downfall of a traffic, which had long been a disgraceful stain on our national character.

Of his moral excellencies, there can be no inducement to offer an overcharged picture to a Society, by many of whose surviving

* Chiefly in the periodical Journals, and in the Transactions of some Medical Societies to which he belonged.

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members he was intimately known and justly appreciated. Foremost among the qualities of his heart, was a warmth of generous emotion, which evinced itself in an enthusiastic admiration of virtue; in an indignant disdain and unqualified reprobation of vice, oppression, or meanness; and in the prompt and unrestrained exercise of the social affections. In temper, he was frank, confiding, and capable of strong and lasting attachments; quick, it must be acknowledged, in his resentments; but remarkably placable, and anxious, whenever he thought he had inflicted a wound, to heal it by redoubled kindness. No man could be more free from all stain of selfishness; more moderate in his desire of worldly success; or more under the influence of habitual contentment. This was in a great measure the result of his having early weighed the comparative value of the different objects of life, and of his steady and consistent pursuit of knowledge and virtue, as the primary ends of an intelligent being.

In very advanced age, though his body was enfeebled, his mind retained much of that wholesome elasticity and vigour, which always belonged to it. He was still enabled, by the almost perfect preservation of his sight, to spend a great portion of every day in reading; but, at this period, he derived greater pleasure from works of literature, than from those of science, and especially from his favourite study of history. During the winter immediately preceding his death, beside several standard historical works, he read with avidity one which had been recently published*; and entered into a critical examination of its merits, with a strength of memory and judgment, that would not have discredited the meridian of his faculties. In his moral character, no change was observable, except that a too great quickness of feeling, of which he had himself been fully conscious, was softened into a serene and complacent temper of mind, varied only by the occasional glow of those benevolent feelings, which continued to exist in him, with unabated ardour, almost to his latest hour. He still continued to receive great pleasure from the society of the young; and to them he

* Dr. Stanier Clark's Life of James the Second.

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was peculiarly acceptable, from the kindness and success with which he studied to promote their rational enjoyments. It was his constant habit to take a cheerful view of the condition of the world; and on all occasions, when the contrary opinion was advanced, to assert the superiority of the times in which he had grown old, over the season of his youth, not only on the unquestionable ground of an increased diffusion of knowledge; but on that of the wider spread of virtuous principles, and the more general prevalence of virtuous habits.

Without encroaching on topics, which are wisely forbidden by the rules of this Society, it may be permitted to me to state, that Mr. Henry was from inquiry and conviction, a zealous advocate of Christianity.—About the middle period of life, a change of opinion led him to separate from the established Church, to whose service he had early been destined; and to join a congregation of Protestant Dissenters. But in discussing differences of religious belief, he was always ready to concede to others that free right of judgment, which he had claimed and exercised for himself; convinced, as he was, that no conclusion to which the understanding may be led, in the honest and zealous search after religious truth, can, without the highest injustice, be made the ground of moral crimination or reproach.

Such is the view of the character of our late President, that has been taken by one, who, in forming it, may be supposed to have been influenced by feelings and recollections, not altogether favourable to an unbiassed exercise of the judgment. That it is coincident, however, with the estimate of others, from whom impartiality may be more reasonably expected, will appear from the following document, which, at the time when it was presented to the Society, declared the sentiments of all those members, who were in the habit of attending its meetings, or of taking an interest in its proceedings.

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" To the Literary and Philosophical Society of Manchester.

" We, the subscribed, beg leave to present, to the Philosophical Society, a portrait of our President, painted by Mr. Allen, which having been in a public exhibition, has been declared by competent judges, to be not only a correct resemblance, but likewise an excellent production of art. Our wish is, that a suitable place may be assigned to it, in the room where our meetings are held: and that, if approved by the Society at large, it may be inscribed by them as an affectionate tribute of respect and gratitude to a man, universally beloved for his conciliating qualities and private worth, and peculiarly endeared to us, by the relation in which he stands, as one of the very few founders of the Society, whom an indulgent Providence has still spared to us; a Philosopher, to whose talents we owe much of the approbation which the Public has bestowed on our labours; and a Member, whose zeal has, for a period of nearly thirty years, been uniformly exerted, in every station, to promote the peace and prosperity of the Institution over which he presides."

Art. II. *Investigation of the Corrections of the Places of the Stars for Aberration and Nutation.*

A. If the earth moved uniformly in a circle, the apparent place of a star would also describe a circle in a plane parallel to that of the ecliptic, its diameter being 40″,51.

This proposition follows immediately from a consideration of the cause of aberration, and is too well known to require further demonstration. The magnitude of the circle is the most accurately determined from the phenomena of Jupiter's satellites; Professor Bessel has indeed remarked, that the observations of Bradley seem to indicate a diameter about a second greater, and that those of the Baron von Lindenau have a similar tendency; Professor Brinkley is also inclined to draw the same conclusion from his own observations; but it is avowedly inconsistent with Mr. Pond's very accurate series of observations on annual parallax, as well as with Professor

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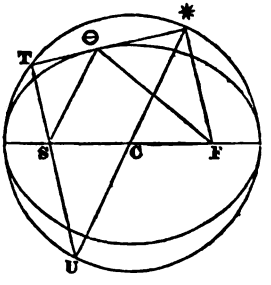
Bessel's own very numerous observations on the pole star; so that he is far from wishing to depart from Delambre's coefficient.

B. The ellipticity of the earth's motion causes the apparent path of the star, in a plane parallel to the ecliptic, to be an eccentric circle.

See *Vince's Principles of Astronomy*, § 291. The perpendicular falling on the tangent from the remoter focus is always proportional to the velocity, being always inversely as the perpendicular falling from the sun's centre; its angular motion is also equal to the angular motion of the tangent, or of the earth's direction, which determines the displacement of the star, consequently its extremity must describe a figure, similar to that which is described by the apparent place of the star in the plane parallel to the ecliptic: but this extremity describes, as is well known, a circle circumscribing the ellipsis; consequently the apparent place of the star describes a circle situated in the same manner with respect to the true place, as the circle circumscribing the ellipsis is situated with respect to the remoter focus, except that the principal diameters are in transverse positions.

C. The angular motion of the star, in its apparent orbit, is always equal to the true heliocentric motion of the earth.



The line C *, drawn from the centre of the circle, to the apparent place of the star, represented in the circle circumscribing the earth's orbit, will always be parallel to S⊖, drawn from the sun to the earth. For if ST be perpendicular to the tangent, and be continued beyond S until SU become equal to * F, the distance from the star's place to the remoter focus, the triangle * T U will be similar to ⊖ T S, because * ⊖ and F * or S U are in the same proportion to each other, as ⊖ T and T S, consequently the angle T * U is equal to T ⊖ S, and * U is parallel to ⊖ S. But * U must pass through the centre C, since * and U must be both in the circle, and * U is equal in length to a diameter, being equal to S ⊖ + ⊖ F.

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D. The apparent place of a star may, therefore, always be referred to a centre, situated between its true place, and its apparent place, at the time of the earth's perihelium, the distance being to the whole mean displacement, as the eccentricity to the mean distance, that is nearly as 1 to 60; and this constant aberration, referred to the plane of the ecliptic, will be ″,34; but since it has no effect on the relative places of the stars at different times, its existence may be neglected in all common cases.

E. The minute circle parallel to the ecliptic, projected on the celestial vault, becomes obviously an ellipsis, of which the semidiameter parallel to the ecliptic retains its original magnitude of 20″,255, and the semidiameter perpendicular to it becomes 20″,255 sin lat.

F. The apparent place of the star in the circular orbit, as referred to its centre, being always 90° in advance of the earth's place, and of course pointing to a place in the ecliptic 90° before the earth, or 90° behind the sun, the line on which the star is found may be considered, from the principles of perspective, as a part of the great circle intersecting the ecliptic in that point, and the angular magnitude of the aberration will always be proportional to the sine of its distance from the star. It is also obvious, that when this circle passes through the pole of the heavens, the aberration will be only in declination, and the aberration in right ascension will vanish; and on the other hand, when the circle becomes perpendicular to the circle of declination, the aberration in declination will vanish: and it follows from the properties of the ellipsis, the ordinates of which are represented by the sines and cosines of arcs of the circle from which it is derived, that the maximum must belong to a point of the circle, at the distance of a quadrant from that which affords no aberration in the respective direction; so that by determining the magnitude of the aberration in this point, we obtain the coefficient for computing it in any other situation.

G. The aberration in right ascension, therefore, will vanish when the sun's longitude is $\odot = b \pm 90°$, b being the sun's

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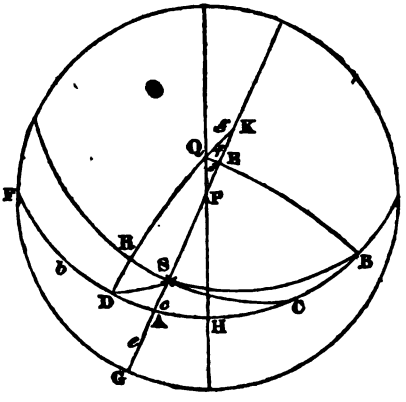

longitude when his right ascension is equal to that of the star; and if α be the right ascension, and ω the obliquity of the ecliptic, tang. b = tang. α sec. ω. The maximum of aberration in right ascension will be when the sun is at the distance A B = 90° from the circle of declination A P, and if B E be perpendicular to A P, the hypotenuse A B being a quadrant, A E will be also a quadrant, and sin. B E will be sin. S B sin. B S E, which is the cosine of the angle made by the line of aberration S B with the parallel of declination, so that sin. B E will represent the true magnitude of the aberration reduced to the latter direction. Now B E is the measure of the angle B A E or F A G = c, and cos. c = cos. F G sin. A F G = cos. α sin. ω. While the sun is between A and B, the aberration being directed to a point behind A, will, of course, be negative with respect to the right ascension; and its complete expression will be 20″,255 sec. δ sin. ($\odot - b - 90°$) sin. c; the secant of the declination δ reducing the direct measure of the aberration to the angular right ascension subtended by it at the pole.

H. For the aberration in declination, if we draw a great circle S C perpendicular to the circle of declination, and let fall on it a perpendicular Q R D from the pole of the ecliptic, it is obvious that C will be the pole of Q R, in the same manner as A is the pole at E B, so that D will be the sun's place when there is no aberration in declination, and the sine of S D

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the direction at the time of the maximum, reduced in the ratio of the radius to the sine of R S D, will be represented by the sine of R D; or of Q K, if R Q be continued till it meet S P, since D Q = R K = S K = 90°, and Q K will be the measure of the maximum. Now, in order to find the point D, we must compute the angle P Q D = 180° — P Q K = 180° — P Q E — E Q K = 180° — d — f; and for d we have tang. P Q E = cot. Q P E sec. P Q = tang. α sec. ω; and in the triangle Q E K, E K = A S, since A E = S K = 90°; but tang. A G = sin. F G tang. A F G = sin. α tang. ω, and calling A G = e, A S = δ — e = E K, and tang.

$$\text{E Q K} = \frac{\text{tang. E K}}{\text{sin. Q E}} = \frac{\text{tang. } (\delta - e)}{\text{cos. B E}} = \frac{\text{tang. } (\delta - e)}{\text{cos. } c,} = \text{tang. } f.$$

and F D = 90° — D H = 90° — D Q H = $d + f$ — 90° which is the sun's longitude when the aberration in declination vanishes, and the displacement being directed towards the point 90° behind the sun, as he advances from D to C, the declination will be diminished while the sine of ☉ — F D is positive, and its magnitude will be 20″,255 sin. (☉ — d — f — 90°) sin. g, g being = Q K, and sin. $QK = \frac{\text{sin. E K}}{\text{sin. E Q K}} = \frac{\text{sin. } \delta - e)}{\text{sin. } f.}$

The values of c and g might also be immediately obtained, from the consideration, that the coefficient of the aberration must initially be the sine of the angle made by the respective great circles with the ecliptic at A and C.

I. It results therefore from this demonstration, that the aberration in right ascension will be 20,″255 sec. δ sin. c sin. (☉ — b — 90°), and in declination 20″,255 sin. g, sin (☉ — d — f — 90°); the values of the coefficients being tang. b = tang. α sec. ω; cos. c = cos. α sin ω; tang. d = tang. α sec. ω; tang. e = sin. α tang. ω; tang. f, $\frac{\text{tang. } (\delta - e)}{\text{cos. } c}$ and sin. $g = \frac{\text{sin. } (\delta - e)}{\text{sin } f}$; expressions which cannot easily be rendered much more simple; although it may sometimes be more convenient in calculation to employ the formulas, adopted by Professor Bessel and others; for the former $\alpha' - \alpha = -20'',255$ sec. δ (sin. ☉ sin. α + cos. ☉ cos. α cos. ω); and for the latter $\delta' - \delta = -20'',255$, (sin. ☉ cos. α sin. δ + cos. ☉ [sin. ω cos. δ — sin. α cos. ω sin. δ]).

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K. The effect of the diurnal aberration is simply to cause every object to approach in a minute degree toward the eastern point of the horizon, the maximum, which occurs on the meridian, being ″,313; so that a transit instrument, exactly perpendicular to its axis, would leave the circumpolar stars a little longer to the east than to the west, and their culmination above the pole would be a little too late, and their inferior transit too early: but the difference can scarcely ever become sensible.

L. The value of the solar and lunar nutation becomes, according to the computations of Lindenau and Bessel, neglecting the thousandths of a second,

$$\begin{aligned}
\alpha' - \alpha = &- 15'',40 \sin. \Omega \\
&- (\ 8'',98 \cos. \Omega \cos. \alpha + 6'',68 \sin. \Omega \sin. \alpha) \tang. \delta \\
&\qquad + \ ''\!,09 \cos. 2\,\Omega \cos. \alpha \tang. \delta \\
&- \ 1'',14 \sin. 2\,\odot \\
&- (\ 0'',58 \cos. 2\,\odot \cos. \alpha + ''\!,50 \sin. 2\,\odot \sin. \alpha) \\
&\qquad \tang. \delta \\
&- \ ''\!,18 \sin. 2\,\mathbb{C} \\
&- (\ ''\!,09 \cos. 2\,\mathbb{C} \cos. \alpha + ''\!,08 \sin. 2\,\mathbb{C} \sin. \alpha) \\
&\qquad \tang. \delta \\
\delta' - \delta = \ & 8'',98 \cos. \Omega \sin. \alpha - 6'',68 \sin. \Omega \cos. \alpha \\
&\qquad\qquad - \ ''\!,09 \cos. 2\,\Omega \sin. \alpha \\
&+ \ ''\!,58 \cos. 2\,\odot \sin. \alpha - \ ''\!,50 \sin. 2\,\odot \cos. \alpha \\
&+ \ ''\!,09 \cos. 2\,\mathbb{C} \sin. \alpha - \ ''\!,08 \sin. 2\,\mathbb{C} \cos. \alpha.
\end{aligned}$$

It is obvious that if we wish to take account of every hundredth of a second, it is quite necessary to introduce all these terms into the computation; but it can only be for the most refined researches of philosophical astronomy that any thing like such a degree of accuracy can be at all required; much less can it be worth our while to pay the least attention to the terms of the higher orders, and the effects of the nutation on the aberration, with which Professor Bessel has found it agreeable to amuse himself. He has given an example of the results of the whole calculation, in a table for finding the true place of the pole star, adapted to its situation at the begin-

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ning of 1815, which will be sufficiently accurate, even if we omit his ten thousandths of seconds.

Correction of the right ascension of α Ursæ Minoris in time, $= \frac{1}{15}(\alpha' - \alpha)$.

$+ 20^s,368 \sin.(\Omega + 256°.40',9)$
$+ \quad ,194 \cos. 2\,\Omega$
$+ \quad 1,327 \sin.(2\,\odot + 254°.46',9)$
$+ \quad ,201 \sin.(2\,\mathfrak{C} + 253°.44')$
$+ \quad ,011 \sin.(2\,\Omega + 329°.24')$
$+ 42,519 \sin.(\odot + 254°.50'.7)$
$+ \quad ,071 \sin.(2\,\odot + 332°.0')$
$+ \quad ,057 \sin.(\odot + \Omega + 332°.23')$
$+ \quad ,010 \sin.(\odot - \Omega + 343°.54')$
$+ \quad ,712 \cos.\varphi \cos.(\mu - 13°.57')$.

For the declination, $\delta' - \delta$.

$+ 6'',837 \sin.(\Omega + 161°.32',5)$
$- \quad ,021 \cos. 2\,\Omega$
$+ \quad ,501 \sin.(2\,\odot + 163°.48'.)$
$+ \quad ,081 \sin.(2\,\mathfrak{C} + 164°.51')$
$+ \quad ,004 \sin.(2\,\Omega + 232°.28')$
$+ 20,102 \sin.(\odot + 167°.48',8)$
$+ \quad ,015 \sin.(2\,\odot + 227°.30')$
$+ \quad ,015 \sin.(\odot + \Omega + 246°.30')$
$+ \quad ,014 \sin.(\odot - \Omega + 264°.50')$
$+ \quad ,313 \cos.\varphi \sin.(\mu - 13°.57')$.

The angle φ is the latitude, and μ the sidereal time expressed in degrees. The laborious author promises new tables of the pole star, calculated upon these principles, which will be published in the fourth part of his astronomical observations.

S. B. L.

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Art. III. *Journal of the Proceedings of* Mr. Burckhardt *in Egypt and Nubia.*

[The following article, chiefly extracted from the *Calcutta Journal*, is prefaced in that publication by a letter from Mr. Salt to Mr. Hamilton, which we have not thought it necessary to reprint, as it appeared originally in the *Quarterly Review*, Vol. XVIII. p. 368.]

Cairo, Oct. 20, 1817.

The interest which the labours of this distinguished traveller have excited among the literati of Europe, and the degree of eager curiosity with which the publication of his Travels is looked for, from the hands of the African Association, under whose direction they are preparing, induces us to believe that the few notices which we have it in our power to give of their lamented author, will not be unacceptable, more particularly as we are enabled to state these from our own personal knowledge of the excellent individual to whom they relate, and as they contain many interesting particulars hitherto unknown.

Mr. Burckhardt was born at Zurich, in Switzerland, about the year 1786. His father was an officer in the military service of the French, and he had a brother in the political service of that country also. He was himself educated chiefly at Berlin, but being disappointed in some promised employment from the French Court, went to England, where he completed his studies during a stay of three years at Cambridge.

On removing to London, he was deceived into hopes of political employment by some of the courtiers there; but being of an active and independent mind, and impatient both of indolent waiting and of humble solicitation, both of which were required of him before he could hope for success, he determined on offering his services to the African Association, to explore for them the interior of Africa.

When he waited on Sir Joseph Banks, the question was naturally asked him, what assurances he could give of his capacity to execute and to suffer all that could be required of him in so

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arduous an undertaking? His reply was simply, the conviction that rested on his own mind of being equal to the combat of any difficulties which might arise in his way. The same conviction must have possessed the worthy President also, for his offer was almost instantly accepted, and arrangements made for his projected voyage.

He remained some time in London to improve himself in the knowledge of botany and mineralogy, which he understood tolerably well; but, as far as we are aware, astronomy and drawing were not familiar to him, nor were they likely, indeed, ever to be called for, travelling, as he was from the first intended to do, as a Mohammedan, and an individual of the humblest class.

Before leaving England he partook of a farewell dinner, which was given to him by the Association, and at which the principal members of that institution attended. The Marquis of Hastings (then Lord Moira,) was of the number of the distinguished personages present, and Mr. Burckhardt had the honour of being seated next to him. The conversation on this occasion naturally tending towards African travellers, the unfortunate Mungo Park was spoken of as having had his ardour rather quickened than damped by all that he had suffered in his first voyage, and having very nobly ventured on his second journey. Lord Moira, addressing Mr. Burckhardt in the most encouraging tone, assured him of his confidence in the success of his enterprise, and expressed his persuasion that he, too, like Park, if returned safely from his first expedition, would not be able to refrain from venturing on a second; when the young Swiss replied, that, as in military affairs, no one was called upon to go on a forlorn hope twice, he thought his Lordship would agree with him, that it would be temerity in a traveller to tempt his fate by such a duplication of danger. He used to repeat this anecdote frequently, and never failed on such occasions to do justice to the distinguished patronage which the Noble Earl was invariably found to shew to science and knowledge in all their departments, and more particularly to the warm and paternal interest which he felt and expressed in his own peculiar case.

After leaving England, in the spring of 1809, he first landed

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at Malta, and it was during his short stay here, while the island was under the government of Sir Alexander Ball, that he first adopted the Mohammedan costume, and suffered his beard to grow; while, in the barbarous dialect of the Maltese, he made his first steps towards the acquisition of the Arabic language.

From hence he sailed to Cyprus and Laodicea, and went by Antioch and the Orontes to Aleppo. He resided here in his own lodgings in a Mohammedan part of the town, but made little scruple of mixing with the Europeans, though he never omitted the duties of the Mohammedan religion, and always retained the Mohammedan costume.

During a stay of two or three years here, he applied himself with great assiduity to the study of the Arabic language, in which he made a proficiency that surprised all who witnessed it. He made from hence also occasional excursions among the Arabs of the Desert, visited Palmyra, and most of the principal ruins of antiquity in Syria, and after passing through the Hauran, and the countries east of the Jordan, and the borders of the Dead Sea, he came from thence to Cairo by the Desert of Suez.

In Egypt, as in Syria, he was visited both by Turks and Christians; and while he mixed freely with both, without seeming to study the concealment of any thing from either, his talents and his virtues were such as to command universal respect and esteem.

From Cairo he proceeded into Upper Egypt and Nubia, and was met there by Mr. Legh, who has written a Journal of his Voyage above the Cataracts, and who makes mention of him therein. This was in the spring of 1813; and in the autumn of the same year, Mr. Burckhardt was still in Upper Egypt, waiting at the town of Esneh on the Nile, for an opportunity to penetrate by land into the higher parts of Nubia, towards Abyssinia and the shores of the Red Sea.

The notices that we possess of the subsequent movements of this distinguished traveller are contained in a Journal kept on the Nile, and afterwards on the Red Sea, in both of which places he was met by the writer of it; and though the form and style of a journal, written while all the impressions it records are yet

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warm upon the mind, are objectionable to some, yet in our opinion it is this very freshness and genuine glow of truth about them, which give to loose memoranda of this description their highest charm, and with this belief we choose rather to hazard the imperfections they may contain, than alter even a phrase of the journal in which they are preserved. We shall confine ourselves, however, to the extracts of such particulars only as bear on the subject of this memoir, though a degree of abruptness and want of connexion will be given to the narrative thereby, but it would be difficult to avoid this without falling into a greater evil.

Ascending the Nile above Hermonthis, Friday, Nov. 26, 1813.

The breeze strengthened every hour, and brought us to Esneh about three o'clock, where we landed to wait on the Kiashef, or Commandant. When the ceremonials of our visit were over, my first inquiry was after a Swiss traveller, whom I had heard was here, and it was a pleasure to me of the highest kind to find my hopes confirmed. The Kiashef politely sent for him, and he entered the room, dressed as an Arab Fellah, with a long beard and blue chemise, having assumed the name of Sheikh Ibrahim, and so perfectly acquired the Arabic language during several years' travels in Egypt and Syria, as to pass among the most suspicious for a native of the country. Our conversation was divided between the most recent intelligence from Europe, as demanded from me, and the local information relative to Egypt kindly given in return by him. We both remained to sup with the Turk, whose attentions were such as I had not yet witnessed among them, and we continued together in close conversation until nearly midnight.

Esneh, or Latopolis, Saturday, Nov. 27.

We had not yet risen, when Sheikh Ibrahim paid me a visit in the boat, and we breakfasted together at sun-rise. It is a circumstance which I shall ever remember with peculiar pleasure, that early as the visit was, we sat upon the mattress extended on

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the cabin floor, from that time until 4 o'clock past midnight—a period of twenty-two hours—without once rising or quitting the boat; and even then, unwilling to break communication abruptly, we lay down to sleep upon the same bed. It would be impossible to describe how delighted we both appeared to feel in the enjoyment of so unexpected a pleasure, as the meeting of persons under such circumstances must always afford; but in a still higher degree to those who think and feel alike, to those whose tastes are similar, whose sentiments are congenial. This was unquestionably our case, and, as if from the fear that time would snatch from us too hastily the opportunity of mutual disclosure, we dispensed with all preparatory ceremony to enter at once upon the task. There were besides all this, a number of incidents that increased the interest of recounting them, from our both witnessing them together, though unconsciously, because unknown to each other. We had heard the same operas in London, on the same occasion; attended the same concerts; seen the same plays; visited the same coffee-houses, and even debated questions repeatedly on the same evening at the British Forum at Piccadilly, of which he was a constant attendant, and a warm admirer of free discussion. He also knew Mr. Edward Lee's family in England; Mr. Maurice, the Librarian of the British Museum; and Mr. Peter Lee, at Malta; he was a fellow-traveller of Mr. Fiat in Syria, and a correspondent of Mr. Renouard in Smyrna; all of whom being known to me also, rendered the topics of our conversation as infinite as they were agreeable. He had been educated at Berlin, and finished his studies at Cambridge; passed several years on the Continent of Europe, and been through all Syria, in the character of a merchant, a priest, and a Bedouin; penetrated through the boundaries of Egypt, nearly to the frontiers of Dongola, and now waited a caravan to depart for Nubia and Abyssinia, intending to come out on the shore of the Red Sea, traverse the Yemen and Arabia, and return to Cairo by the Desert in about 18 months. To a classic education he added a perfect knowledge of French, Italian, German, and Arabic; had studied the piano-forte under the best masters until 18; was a passionate admirer of poetry and music; and warmly susceptible

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of the noblest passions of the human heart. How then was it possible not to be enamoured of such a man's society, an enjoyment so seldom falling to the lot of wanderers?

Esneh, Sunday, Nov. 28.

We passed the day again together, and devoted it to an examination of the town, and the remains of antiquity it possesses.

Ibrahim returned to the boat with me at night, and we continued up nearly as late as on the preceding one, as busily and as happily engaged as before. For myself, I feared the moment of an interview would escape too fast, and that after we had parted, I should still have a thousand questions to ask, which he could have answered.

Contra-Latopolis, Monday, Nov. 29.

Breakfasting together, we took the boat to the opposite side of the river, and walked to the ruined fragments of Contra-Latona, as called by Arrowsmith; by others, with more propriety, Contra-Latopolis.

I had fixed my departure for this morning, yet we had dined and suffered the shadows of the evening to close upon us before we thought of separation; and I am persuaded both were willing to delay it, although our long night conversations had so broken in upon our rest, as to occasion inconvenience to both parties, but more particularly to Ibrahim, who had for some months been suffering severely from an inveterate ophthalmia, to which the night air is poison. It was agreed, however, that our interview should break up at midnight, that I might depart with the morning's dawn. There was but little hope of our meeting again, and yet we talked of such a circumstance as though we really anticipated it, either in the Red Sea, the Levant, or in England.

Ancient Eliethias, Tuesday, Nov. 30.

We left Esneh with the earliest dawn of light, and with a faint but steady breeze continued to make some progress against the stream. I had passed the three last days so happily in the

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society of Ibrahim, that I felt his loss as severely as though our intimacy had been of much longer duration, and it had the effect of rendering me really melancholy throughout the day; nor was it an affected sensibility, though perhaps so short a period seems insufficient to have inspired it: yet the distance from every other friend, the occasion, and the place of meeting, were of themselves strong auxiliaries, independent of the very high attraction of such talents, manners, and sentiments.

The writer of the Journal continued his progress up the Nile from hence, and after passing the cataracts of Assouan, and, penetrating beyond the tropic into Nubia, returned again, after an absence of about 15 days, to Esneh, when the following letter from Mr. Burckhardt was put into his hands by an old Arab, who met him on the river's bank, when landing before sun-rise.

MY DEAR SIR, *Esneh, Dec.* 13, 1813.

The regret I feel at being obliged to leave Esneh before your return, much outweighs the pleasure I should else have experienced from being at last enabled to put an end to my tedious stay in Upper Egypt. But this is the unfortunate lot of travellers. They must suddenly part with persons whose character and acquirements have inspired them with the greatest esteem, in order to mix for months with beings, the shapes of whose bodies alone entitle them to the name of human. The hope of mutual remembrance is, then, the only consolation; and, on my part, I beg you to rest assured, that the memory of the two days you kindly granted me at Esneh, shall never be obliterated from my mind and heart. I am afraid the state of Nubia, after the late invasion of the Osmanlys, has not been altogether propitious to your pursuits. I had expected a note from you from Assouan, but your Reis has not yet made his appearance. If you repair to Syria, have the goodness to remember me to Mr. Chaboceau, the French Doctor—and at Aleppo, to my friends Messrs. Barker, Masseyk, and other families. I should be much interested to receive from you some details relative to your excur-

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sions in Syria, and more particularly to those *trans Jordanem*. I forgot to mention to you that there is a ruined city, called Om-el-Djemal, at the distance of about 25 miles S. E. from Bosra in the Hauran. I have not been able to visit that spot, you may, perhaps, be more fortunate. I understood, during my stay at Basra, that there are a great number of Greek inscriptions to be met with at Om-el-Djemal. The Chief of the Druses of Hauran, Shibely, can afford you the means to see that place.

With the liveliest wishes for your welfare, and the complete success of your projects, I have the honour to be, my dear Sir,

Your most obedient humble Servant,

IBRAHIM.

P. S.—A letter addressed to Colonel Missett will always reach me, at least for the two next years to come.

On inquiring when the writer had departed, the old man told me he had received the letter on the preceding evening, with orders to present it me on my arrival, and that Ibrahim intended leaving Esneh at midnight. I immediately despatched my servant to his house, and some fortunate obstacles having delayed his departure a few hours beyond the appointed one, he was in the act of mounting his camel to repair to the caravan rendezvous, without knowing of our being here, or even expecting our return so soon. He came instantly to the boat, and our joy at meeting was as powerful as the regret we both appeared to have felt at our former separation, nor could there have been any doubt of its mutual sincerity.

The writer of the Journal afterwards continued his way to Cairo, and from thence to Suez, where he embarked on the Red Sea, and after a disastrous voyage, rendered still more painful by illness, reached Jedda, where he again met with Mr. Burckhardt, and obtained from him a detailed account of what had befallen him since their separation.—This event is thus described in the Journal before extracted from.

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Arrived at Jedda, Sunday, November 6.

In the course of the night I had experienced a return of my fever, accompanied with the most alarming symptoms, and intervals of the wildest delirium, so that, independent of my actual sufferings from the force of the disease, and the want of every thing that could afford either nourishment or comfort, I was unable any longer to continue my observations on our route, and only remember that after a good run before a strong breeze we anchored at Jedda about sun-set among a fleet of other Dows, and at the distance of half a mile from the town.

The hazardous state of my existence was of itself sufficient to render me impatient to be landed, and the promise of a reward happily obtained me that favour from the Reis, who accompanied us himself to the house of Jellani, an Arab merchant, to whom letters of introduction had been furnished me by Signor Macardle, in Egypt. My weakness was so extreme, that I was unable even to clothe myself with the garments necessary for a protection from the night air before I left the Dow, and on landing, it became necessary to be borne to Jellani's residence by a party of men called for that purpose.

Jedda, Monday, November 7.

The fatiguing exertions of yesterday had so increased my illness that I was unable to lift even my head from my pillow without assistance, and was necessarily confined to my bed. My arrival and my situation soon becoming known, I was visited in the course of the morning by a Candiot Greek, resident in the place, and a young Scotchman in the habit of a Turkish soldier, who called himself Othman Aga, and represented himself as being in the service of an Osmanly Bey on military duty here under the Pasha of Egypt. From both of these men I had the happiness of receiving the most sympathizing and kind attentions, one or the other of them continuing by the side of my bed throughout the day, furnishing me with every thing they possessed the means of procuring, although my illness rather gained force than abated.

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Jedda, Tuesday, November 8.

My spirits were elated beyond description at hearing this morning of an English vessel being in the port, having anchored on the preceding evening, as it gave me every reason to hope that by procuring medicines and some desirable articles of food from her, my life might yet be rescued from that decline to which it was rapidly hastening. As the cheering effect of this welcome information enabled me to sit up on the bed, supported with cushions, I devoted the intervals between necessary repose to writing to my friend Mr. Burckhardt, who I learnt was at Mecca, as well as the Pasha's Physician at Tayf, in French and Italian, as I knew not which of these languages he understood or corresponded in.

Jedda, Wednesday, November 9.

The Captain of the English vessel having been on shore yesterday, for the transaction of the necessary custom-house business without calling at Jellani's house, I felt persuaded that he was not aware of one of his countrymen being there in sickness and distress; in consequence of which I addressed to him a short note, in which I merely stated my desire to be favoured with a visit from him, and in the course of the morning, I had the satisfaction of seeing my request complied with, as he came accompanied by two of his passengers, a Baghdadian and an Arab, voyaging here as merchants and as pilgrims.

As I was then in bed, Captain Boog, for that was the gentleman's name, very kindly solicited me to remove on board his ship, where the superior purity of the air, and the comforts which it would be in his power to offer me, would be likely to facilitate the restoration of my health, and independently of such an arrangement being most congenial with my wishes, the frank and warm manner in which it was offered, left me no room to doubt of its sincerity, and I accordingly accepted it without hesitation, consenting to attempt an exertion for that purpose after sun-set in the cool of the evening.

On the following morning I resumed my European habit, al-

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though I now possessed but few clothes of any sort, since the loss of my trunks on our passage down.

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From this period until the 18th, I continued to receive the kindest and most consoling attentions from Captain Boog, and by the help of medicines and nourishing diet, daily gained strength.

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My writing was entirely abandoned during this period from the pain both of the head and breast which it occasioned, and it was in this interval that I received the following letter from Mr. Burckhardt.

Mekke, 2d Zeelhadj, 1229.

My dear Sir,

Othman Aga arrives this moment, and tells me that you are at Jedda. My joy at knowing you so near is damped only by the news of your illness. I should have immediately set out for Jedda, to see you before the Hadj, but after to-morrow the gates of Jedda will be shut, so there will be no means of conveyance between that place and Mekke, till after the Hadj. My project was to go immediately after the Hadj to Medineh, but I sacrifice it willingly for the pleasure of shaking hands with you, and consoling you a little during your tedious stay at Jedda. You may, therefore, expect me about the 14th or 15th of this month.

None of the letters of Djeilany have yet reached me here, nor did Othman's letter arrive to its address: I should have saluted you long before this time. I am in good health, and trust you will soon be restored likewise, for the climate of Jedda is only unhealthy during the first week of the stranger's stay there.

Believe me, my dear Sir, most sincerely your's,

IBRAHIM.

I give this letter in charge to Djeilany.

P. S.—I beg you not to mention my person too often at Jedda; the Pasha might else be confirmed in his idea that I have the India Company's interest as a guide in the pursuit of my travels. If I see the Pasha during the Hadj at Arafaat or Mekke, and that he mentions your project to me, I shall then endeavour to

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give him a satisfactory explanation of it; but the strange situation in which I am placed with respect to the Pasha, forbids my opening the discourse with your projects; it also might very likely defeat mine. Never mention the idea of sailing strait from Mokha to Suez to any man at Jedda, it would put all the Djeilanys on their guard.

I shall certainly shake hands with you at Jedda, but my stay with you, I am afraid, can only be for a few days.

Excuse my bad hand, style, and paper.

Giovanni Bosari the Pasha's Physician, to whom you have written, reads Italian with great pains, and certainly is not able to understand the true meaning of any phrase above the vulgar cant of letter style.

Jedda, Tuesday, November 29.

The present was a day commenced in anxious expectation, and terminated in unusual pleasure. The boat had been sent on shore early in the morning to wait for my friend Ibrahim, and he had been faithful to his promise, having left Mecca immediately on the termination of the Hadj, and arrived here in the course of the day. He came off to us after sun-set, and our joy at meeting was extreme. For my own part, I felt on the occasion, what I had often felt before on similar ones, a total incapacity to express the happiness which this interview occasioned me, and on his the same effect was visible; those fetters were, however, gradually loosened, and our mutual sensations found a clearer and a warmer utterance, when the shock of joy at meeting had subsided into calm.

Nothing was more natural than that our conversation should be made up of anxious inquiries after the incidents which had severally befallen us since our parting at Esneh, in Upper Egypt. He had performed a perilous and fatiguing voyage, and the changes and novelties I had seen, though less hazardous in their attainment, were scarcely less various, or less interesting to us both, than his own.

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Jedda, Wednesday, November 30.

We awoke but to the enjoyment of anticipated gratifications, took our sun-rise walk upon the poop, while Ibrahim indulged in his morning pipe and coffee, assembled with the appetites of health around the breakfast table, and lounged there after the removal of the cloth until long past noon, in the delightful occupation of alternately pressing upon our guest the natural suggestions of eager inquiry, and being invariably gratified from his answers to them with new and interesting information.

As his recital was now more unbroken in its connexion than the abrupt transitions and frequent interruptions of the preceding evening suffered it to be, we learnt that finding himself in possession of a few days of leisure, after my taking leave of him at Esneh, by the postponement of the Nubian caravan's departure, he had mounted his dromedary, and followed me along the banks of the Nile, hoping to have overtaken our boat at the ancient Thebes, where I proposed making some stay, and he was disappointed in the extreme to find on his arrival at Keneh, that I had just left it for Cosseir. As I had given to the Copt Raffaelli there no reason to expect my return, Ibrahim, remounted his beast, and retraced his steps to Esneh, where he remained until February, when he joined the caravan at a village near Assouan, and proceeded with it toward the Nubian Desert, on the left or east of the Nile. During his stay in Upper Egypt, his dress had been that of the Fellahs, merely a blue cotton shirt, drawers, turban, *&c.*, but this, poor as it is, being thought too symbolic of wealth to travel with among the inhabitants of the wastes he had to pass, was exchanged for a coarse brown goat's wool shirt, a simple tarboosh or scull cap, and a pair of Bedouin sandals. Having discharged his Arab servant, he placed the little baggage he possessed, consisting chiefly of provisions for the voyage, and a few articles of merchandise, such as soap, nutmegs, pepper, spices, *&c.*, on his camel, and rode himself on an ass, which he had purchased expressly for the journey; as his camel, however, was not laden to the extent which it was capable of bearing, this was conceived to be an extravagance, which could only be in-

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dulged in by a rich man; and to remove such impression, he found it at last necessary to sell the beast, and distribute his small parcels on the backs of laden camels, paying to their proprietors a small sum for its conveyance. Great delays were experienced throughout the journey, and the whole of the caravan suffered considerably for want of water, in the course of their route, the hot and dry season having exhausted many of the wells at the principal stations on which they depended for supply. They at length reached Shandy, on the banks of the Nile, where the most important of their wants were supplied by its stream. This settlement, formed of an assemblage of about twenty small villages, scattered near each other, and in this respect resembling Salaheah in Lower Egypt, has succeeded Sennaar as the grand rendezvous of the Nubian caravans, and the chief mart of Ethiopian commerce, which consists chiefly in slaves and camels, collected from Darfour and Abyssinia, and sent with their elephants' teeth, gold, ostrich feathers, tamarinds, gums, &c., into Egypt.

Their stay at Shandy was prolonged for some time, and among the numberless anecdotes which Ibrahim related to us as having witnessed during his stay there, he assured us that the rats from being unmolested had increased to such numbers, and acquired such confidence, that it was impossible to sleep either in dwellings or in the fields, without being literally covered by these annoying animals who walked over the body in troops, perfectly fearless and unconcerned. He declared that often while extended on the ground with merely a shirt on, either to repose in the shade by day, or to seek sleep at night, these intruders had marched up, and began to nibble his flesh as he lay awake.

On departing from Shandy with a caravan for Suakin, they directed their course north-easterly, and pursued their route along a double chain of mountains, clothed with forests of trees resembling the larch, and enclosing between their bases a long and narrow valley of extraordinary fertility. Cultivation, however, was by no means general, as the whole tract of country through which they passed, was inhabited by Bedouin Arabs, of

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a character infinitely more savage, as well as more treacherous and wicked than the Bedouins of Syria, or those on the borders of Egypt. Ibrahim's reasons for not visiting Sennaar and Abyssinia, were, that both these countries had been already visited by Bruce, and could offer less novelty, (more particularly the latter, since the excursions of Captain Rudland and Mr. Salt,) than his traversing a tract of country perfectly unknown; he therefore wisely preferred the latter, both for his own individual satisfaction, as well as for the opportunity of presenting the African Association with information entirely new. In this journey he possessed a boy slave, purchased at Shandy for sixteen dollars, but he was too young to be of any assistance to him in the most fatiguing duties of travelling, and served him only as a cook to prepare his coffee, and bake his cakes. At the evening halt, he told us, when the hour of supper was past, the cries of women were to be heard throughout the camp, the merchants having always among their stock, a number of young female slaves, whom they treat in the most brutal manner, and with whose society they solace themselves, during the hours devoted to repose from the fatigues of the journey.

On reaching Suakin, a further delay was occasioned by the want of boats, and therefore Ibrahim's stay at that place was also longer than he wished it to have been. He described it as a miserable assemblage of dwellings, with few inhabitants, though presided over by a most despotic governor, who exacts heavy duties on all kinds of merchandise passing through his port, and this despotism he exercises without any other aid than that of four soldiers in his pay: so indisposed, or so incapable are the traders, of offering any resistance to his arbitrary power.

Crossing at length from Suakin to Jedda, Ibrahim reached the latter place in excellent health and spirits, but wretchedly clad, and without money. His appearance stood in the way of his receiving assistance from Jellani, the British agent here, who being an Arab, like all his countrymen, regard appearances only as the criterion of a man's worth or credit. His applications to the Pasha's physician, Signior Giovanni Bozari, was equally un-

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successful, as he found sufficient excuses to plead in proof of his incapacity to befriend him; so that he was reduced to the painful alternative of selling his slave, for whom he obtained fifty dollars, although they parted with every mutual reluctance, and the boy with tears.

This is merely the outline of the interesting narrative with which Ibrahim delighted and amused us by the innumerable anecdotes that his memory furnished him with to enliven the recital. They would occupy days to record, but will not soon be forgotten.

In such occasional intervals as were devoted to conversation, my inquiries were principally directed to the trade of Nubia and Abyssinia, with a view to ascertain how far there was a probability of being able to draw a portion of it from the interior to the sea-ports, so that by touching there on a voyage from India to Suez, its productions might form a part of the cargo for Egypt. In answer to such inquiries Ibrahim informed us that throughout the whole of these countries, camels and slaves were the chief articles of commerce, both in number and value, and these were collected from all the surrounding districts at Shandy on the Nile, to form the caravan for Egypt, which departed and returned once in the year only. During his stay at that place, the price of good camels was from ten to twelve dollars, which sold at Cairo for fifty; and slaves, divided into three classes, according to their age and sex, varied in their price from 10 to 15 dollars, selling also at Cairo from 80 to 120, those of Sennaar and Habesh being preferred to those of Darfoor, who generally went in caravans by another route through the Oasis of Elwah and formed their rendezvous at Siout in Upper Egypt. On camels no duty was exacted in their route, but on slaves taxes are payable at separate districts through which they have to pass, making the profit on both nearly equal, and the value of a good camel and a good slave very nearly the same to the dealer.

By these caravans, Gum Arabic is also sent in large quantities to Cairo, as well as tamarinds, elephants' teeth, gold, either in bars or large grains, but never in the state which is called

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gold dust, and ostrich feathers, upon which two last articles there is a considerable profit, on the former 30, and on the latter 150 per cent.

With regard to such portion of the trade as might be diverted from its accustomed channels, it is clear that neither camels nor slaves could form any part, the former being an animal impossible to be taken on board a laden ship, and the latter being prohibited by our excellent laws; but all the other articles might certainly be drawn to the coast, by establishing a resident agent there for the purpose of ensuring to the dealers from the interior a ready purchase and prompt payment: and the trifling expense at which they could be conveyed to Suez by sea, when compared with the heavy charges of a long land journey by the caravan to Egypt, would of itself leave a sufficient profit, independent of the gain that the trader would be sure of realizing on articles so little subject to variation in their value. To these might be added, the large water skins for camels, from the hides of the buffalo, and the courbatches, or whips, made from the hide of the hippopotamus, both articles of extensive consumption throughout all Egypt.

If the residents at Massowah and Suakin, with whom such trade was opened, could be prevailed on to bring those articles to Mokha, and there deposit them with an agent who should be able to give them further encouragement by prompt payment, the advantages would be considerable in favour of the ship on board of which they were to be laden, as during her stay at that port, for the shipment of Yemen coffee, gums, &c., such articles could be taken on board at the same time to complete her cargo, and the delay and danger of entering the Abyssinian ports thus avoided, so that she might perform her voyage direct to Suez.

At this moment there exists a trade between Suakin and Jedda, although extremely limited in its extent. The principal articles which compose the shipments from the African side are gum Arabic and gold; on the former of which, though dirty, ill packed, and even adulterated with foreign substances, there is a profit of 25 per cent., and on the latter a gain of 20, which

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hardly ever varies. It is true that the voyage is performed across a sea beset with reefs and shoals, presenting to ignorant natives in their wretched boats, all the perils of a Pacific navigation, but as they have almost always fine weather, and sail only with a favourable wind, they run across in four or five days from shore to shore, and make their returns from Jedda in common clothing, ordinary arms, &c.

Jedda, Friday, December 2.

As we were particularly desirous of hearing from our Mussulman guest some account of his pilgrimage to Mecca, in continuation of the narrative of his travels, it formed the subject of his communications to us between the hours of breakfast and dinner, and we found his conversation at all times so gratifying that every other occupation was waved to listen to it. Fortunately the duties of the ship did not at all require the personal attention of Captain Boog for a moment, and for myself I could sacrifice most willingly whatever disposition for other employments might have existed for the superior pleasure of being thus at once so agreeably entertained and informed; so that we sat at the table for hours in continuation without once moving from our seats, until the preparations for a second meal warned us that we had taken no exercise since our first, when we walked under the awning of the quarter-deck, or enjoyed the purer freshness of the breeze upon the poop above.

The town of Jedda being encompassed by a wall toward the land, has on that side a gate which is called the gate of Mecca, through which none but the faithful are allowed either to enter or to go out on pain of death. From this gate the pilgrimage is considered to commence, and it is performed in a variety of ways, according to the devotion or the means of the pilgrim. The more devout strip themselves entirely of their ordinary dress, and substitute the haram, either of muslin or cotton, which encircles their waist, is brought up over one shoulder, and the ends there united in a knot; the head and feet are then bared, and the journey to the holy city is performed by them on foot. Some of the most devout even undertake the whole of the pil-

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grimage from very remote parts of Asia and Africa on foot; but these are acts of merit not positively enjoined. The Pashas, Beys, and other distinguished personages are so luxurious in their harams, or robes of pilgrimage, as to have them often of white Cashmere shawls, but they must be large and ample, as it is forbidden to use any other than a perfect garment, and without rent or seam. Arms also are suffered to be worn at a moment like the present, when the holy places are encompassed with enemies striving for their possession, but in times of general tranquillity the bearing of any species of weapon is strictly prohibited. As, however, by far the greater number of those who visit Mecca on pilgrimage unite commercial speculations with devotion, and frequently make it the chief end of their journey, they court no more difficulties or privations than such as are absolutely enjoined them by the Koran, and quitting Jedda in their usual dress, halt at a certain village at a short distance from the city, where the haram must be put on, and the rest of the journey performed on foot, in conformity with the prescribed rule of their religion.

It was in this manner that Ibrahim wisely chose to journey, and leaving Jedda about sun-set on a camel, he arrived sufficiently early at the appointed halt, to enter the holy city in the cool of the morning. His astonishing proficiency in the language, his whole appearance, now rendered so perfectly Arab-like, by a tanned skin, coarse hands and feet, and a long beard, as well as his intimate knowledge of the precepts of their religion, and a practical acquaintance with its ceremonies, all contributed to shelter him from the slightest suspicion of being an infidel; although by the gradual initiation which he obtained from travel and observation, into all the mysteries of their prayers, prostrations, and ablutions, he had escaped the otherwise indispensable rite of circumcision, so that while still an "uncircumcised dog," he passed as a true believer.

His first duty after entering the city was to visit the Great Mosque, to walk seven times round the Kaaba, which the Mahomedans consider to have been built by Abraham, and salute the celebrated black stone there, with the other acts of devo-

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tion and worship common in all their temples. He described the mosque as a spacious and even magnificent building, if the power of producing an imposing effect may give a claim to such an epithet. The encircling colonnade surmounted by a continuation of small domes, the vast courts and light minarets, with the riches displayed on the inside, he found perfectly correspondent to the view given in Niebuhr's Travels, from drawings commonly sold at Jedda, and consistent with that writer's description of the building from report; and though if minutely examined with the criticism of an architect, or even by an eye accustomed to admire the beautiful details of Egyptian, Grecian, and Roman architecture, it would be pronounced contemptible in the extreme, yet as a whole, its effect was grand, more particularly when crowded with admiring devotees.

The city of Mecca is extensive, when compared with the towns and villages by which it is surrounded, but its greatest length scarcely exceeds a geographic mile. Its shape is irregular, the buildings being divided into three principal groups, which run off like tongues into the surrounding plains. Of its stationary inhabitants it is extremely difficult to ascertain the number, without a residence there either before or after the Hadj; but of the pilgrims, Ibrahim assured us that there were considerably more than a hundred thousand, principally Asiatics, from Hindoostan, the Malay Islands, and the most remote parts of India; from Persia, Syria, and Turkey in Asia Minor. The Egyptians were the only African people there, as the great western caravan of the Mugrebins from Tombuctoo, the whole coast of Barbary from Ceuta to Barca, the kingdoms of Fezzan and Bournou, the banks of the Niger, and the northern edges of the Soudan countries, had not arrived this year. Indeed, so great was the influx of Asiatic pilgrims that the non-arrivals of the Africans was considered a matter of congratulation, as the city would have been incapable of containing them all, and the desert and unproductive country by which it is surrounded could not have furnished them with supplies, particularly of water, an article of the first importance.

It is as a mart of commerce, however, that Mecca derives its

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chief importance when considered as the capital of Arabia. At this period of the Hadj, there is not probably one man in a thousand who does not engage in mercantile transactions (if the military, who are few in number, are excepted.) The caravans from Damascus and Baghdad are charged with the richest manufactures and productions of India, Syria, and Persia, in muslins, shawls, gold stuffs, carpets, drugs, and precious stones. The fleets from Suez bring down the coarser fabrics of Egypt, in linen, woollen, and cotton articles of ordinary dress, as well as richer garments of European cloth with Cairo-manufactured horse trappings, highly ornamented arms, particularly sabres and pistols for the military, and muskets, German-blade swords, and crooked knives, all of inferior qualities, for the Arabs. To this is added the celebrated red woollen caps of Tunis, with a commoner kind in imitation of them from Europe, red and yellow leather shoes and slippers, some few British cotton goods, and as much ammunition as they can safely smuggle on shore. These form the investments of private traders, besides which immense quantities of corn, rice, dourra, and other grains, are sent from Egypt both by the vessels from Suez, and by the land caravans through Medina to Mecca, all on account of the Pasha himself, who has monopolized the whole of that trade.

The wealth and population, thus collected, render the city so much the scene of bustle and activity, that from sun-rise until noon, during every day of the Hadj, the public bazars are crowded so as to render a passage through them absolutely impossible. Ibrahim assured us that the ordinary bazars of Cairo, thronged as they always are to an excess, were yet but thinly peopled in comparison to those of Mecca at the season of the pilgrimage. It is here that the rich ladings of the caravans are exposed to public inspection and sale, in separate ranges, appropriated to the reception of their respective articles only, as usual throughout the East. These goods are sometimes sold in large parcels to private purchasers, but much more generally in small ones by public auction, called by the Turks, " Haratch," the manner of doing which is by a man's holding aloft the ar-

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ticle to be sold, that it may be seen by every one, parading to and fro the small space before his magazine, and offering it for inspection to the bidders, whose prices he repeats with a loud voice, and transfers it to the possession of him who has offered the last and highest, as in England. Such is the manner in which goods on the spot are disposed of, but cargoes lying at Jedda, unlanded, are sometimes sold there by sample and pattern, although it is always more advantageous to the seller to have his property transported to the city, and exposed in the bazars, because as all goods sold at public auction are paid for by cash on delivery, and those disposed of by private barter are immediately replaced by the articles bargained for on the spot, the seller is certain of effecting his sale; while articles treated for by sample, if lying at Jedda, leave the purchaser too long an interval to alter his intention, and as deposits are never made in such cases from a mutual suspicion of each other's integrity, the proprietor of the goods has very often to seek a vent for his commodities in another quarter, with the additional mortification of losing the only season for profitable sales.

In this manner, the East Indian from Bengal and Hindostan exchanges his rice, spices, and manufactured goods, for articles suited to the markets of his own country; the Persian barters his productions for others in demand at Isfahaun; the Syrian sells his rich stuffs for the coffee of Yemen, and the gums of Africa and Arabia; and the Egyptian obtains in return for his coarser manufactures the productions also of these countries, to meet a ready sale at Cairo; while the gold of Abyssinia furnishes a medium of exchange, by which the differences of value in all transfers effected is easily made up, and the most intricate accounts between men of separate nations and of separate languages, easily and satisfactorily adjusted.

Some merchants, indeed, find this trade so extremely profitable, that they are to be found here among the pilgrims every year, notwithstanding the humiliation they are obliged to undergo in always entering the holy city in that character, encircled only by the Haram, bare-headed, and on foot, as it is for-

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bidden for any one to enter it in any other way, not exempting age, rank, or sex, even though they may have entered it for any number of times before.

During his first short stay at Mecca, Ibrahim observed the town with considerable attention, and, as usual, related to us innumerable anecdotes descriptive of the manners of the various classes there, which were full of interest.

Jedda, Saturday, December 3.

The period which my kind friend had limited for his stay with us having expired, as he was naturally anxious to secure the benefit of joining the Medina caravan, whose departure was fixed for Monday next, we received from him at breakfast the unwelcome intelligence that he must leave us to-day for Mecca. It was as painful as it was unexpected, as he had purposely avoided saying any thing on the subject of our separation until the hour itself should come. He remained with us, however, until noon; and it is impossible, while I remember him, that I should ever forget the kindness of the solicitude which he expressed on my behalf, and the interest he evinced in the success of my present pursuits. For myself I felt all which the partings of the warmest and most sincere friends could inspire, and those feelings were heightened by the consideration of the hazardous enterprise he was about to enter on, in exploring the wild and savage countries of interior Africa.

On leaving the ship's side, he told us there was a possibility of the caravan's departure being postponed, and thus consoled us with a hope of his return at sun-set, if such should be the case. After his departure, however, we scarcely suffered ourselves to indulge it, and both Captain Boog and myself felt as if we had parted from a very dear and long-tried friend, rather than from a stranger-guest of a few days.

At sun-set we were both on the quarter-deck with telescopes in hand watching eagerly the movements of the jolly-boat as she came from the shore. On her approach we discovered by his white turban and holy green Jubbé, that Ibrahim was

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there. Our joy at re-meeting was mutual and extreme. Dinner was immediately served, and all proved, by the elevation of their spirits, as well as by the cheerfulness which supported our conversation until past midnight, how much we rejoiced at his return.

Jedda, Sunday, December 4.

As if to rescue time even from sleep, and seize the moments we were yet to be together, before they should have flown unenjoyed, we had each risen earlier than usual this morning. The pipe and coffee, now difficult to be dispensed with, welcomed Ibrahim from his slumbers, and as our morning walk was retarded by the washing of the decks, we were entertained at intervals with anecdotes of Syrian manners both among the Arabs and the Franks, collected during his stay at the two principal cities, Aleppo and Damascus;—which, being as characteristic as they were new and entertaining, afforded us a very high gratification.

After breakfast, the Captain's hookah was lighted, Ibrahim's pipe renewed, and each preserved their seats with all the gravity, and, on our parts, the expectation, too, which marks the auditors of a public assembly when some interesting discussion is about to take place, or some fine oration about to be delivered. Nor was the expectation defeated, while we listened to an account of his journey from Mecca to Taif, his interview with the Pasha there, *&c.*

The distance between these two cities is about fifty miles, and forms a three days' journey on asses and camels; the whole of the road is over a mountainous and barren country, although there are scattered villages lying in the way, but the inhabitants, from the desert and infertile state of the grounds they occupy, are merely shepherds, and in a still worse condition than the villagers of Egypt. The city or town of Taif is situated on an eminence, the base of which is clothed with some verdure, among which are even gardens that produce good supplies of vegetables and fruit for the inhabitants, who are in general Arabs, living by the little trade which exists among themselves.

On his arrival at Taif, Ibrahim addressed himself to Sig-

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nor Giovanni Bosari, the physician of the Pasha, who was also here at this moment, it being his chief military depôt. The reception he met with from this Greek was such as all the Levantines, but particularly those of his own nation, know so well how to bestow, even on persons whom they hate or despise, that is, highly flattering and complimentary, full of the most friendly professions, and often-repeated assurances of welcome to the participation of every thing his house could afford him. At the evening divan, where the physician attended as an officer of the court, the Pasha was made acquainted with Ibrahim's arrival at Taif; and having known him in Egypt, previous to the undertaking of his Nubian expedition, he expressed a strong desire to see him. On learning that he had come from Mecca, which city he had entered as a pilgrim of the Moslem faith, his surprise was extreme, as he could not prevail on himself to believe that he had been regularly initiated into Mahommedanism. The birth of this surprise was naturally accompanied by an increase of curiosity, and he therefore despatched his physician immediately to bring him to the divan, premising, however, that he could only receive him as an Englishman and a Christian. On those conditions Ibrahim refused to go, returning by the messenger at the same time his most respectful compliments to his Highness, and assuring him of his readiness to attend his commands, but as a true and faithful mussulman only. One of the chief of the Ulema, and a Mollah, being present, they ventured to express their opinions that it was proper for him to be received in that character, if he was indeed a true believer, and they were firmly persuaded that no other could ever enter Mecca. The Pasha yielding, therefore, to superior theological knowledge, revoked the conditions of his visit, and Ibrahim was admitted as one of the faithful, to give the "Salaam Alaikum," and receive the "Alaikum Salaam" in return. He remained with them until a late hour, examined on the one hand by the Pasha on the political affairs of Europe, and on the other by the Mollah on the precepts and doctrines of the Koran, with all the injunctions of the book, and traditions relative to the washings, prayers, and customs necessary to be observed by a

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believer. The Pasha, acquainted with the unexpected changes that had taken place in France, and the general peace subsequently arranged between all the European powers, expressed considerable alarm for the safety of Egypt, feeling persuaded, he said, that the English had always an intention of taking possession of it, as a link of value in the chain by which they would thus connect themselves with their Indian possessions; and that since the Russians were already making warlike movements, and assembling their troops on the Russian frontier, nothing could be a fairer plea for the British nation to carry its project into execution, than that of checking the conquests, and opposing the ambitious designs of so overgrown a power, and one so likely to become a dangerous rival, as that of Russia. It was in consequence of these apprehensions, that he looked with anxiety for the termination of the Arabian war, and was desirous of obtaining such advantages over the Wahabees as would enable him to return to the personal government of his own country, not for the sake of preparing for its defence, which he must have known to be in vain against an European army, under an able general, but for the purpose, most probably, of so securing his wealth as to be certain of possessing it in case of his being obliged to abandon his province to its conquerors.

In the course of this conversation, the Pasha so often expressed his doubts of Ibrahim's having passed the ordeal necessary to be borne by all who embrace the Moslem faith, that the latter found it really necessary to preserve the appearance of having done so, by an offer made in the presence of the Mollah to give ocular demonstration to any persons whom he might think proper to appoint for an examination of the doubted fact. The seeming frankness with which this offer was made, and the readiness with which he replied to all the questions of this member of the Ulema, on the subject of doctrinal and practical religion, gave full conviction, and drew from him so complete an assurance of it, that he waved availing himself of the offered examination as perfectly unnecessary; so that the Pasha, though still unconvinced, was compelled to yield to the higher autho-

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rity of his venerable superior, who united in his person the sacred characters of Judge and Priest.

The result of this interview was so extremely favourable to Ibrahim, that it was followed by the joint invitations of both those distinguished personages to favour them with frequent visits, and on the part of the Pasha by a present of a complete Turkish dress, with a sum of money, which at that moment were both of them very seasonable supplies. During his stay, therefore, at Taif, which was very short, he continued to visit both the Pasha and the Mollah very frequently, was favoured often with long and private conferences from them both, and invariably received every mark of distinction and respect.

Ibrahim had often told us of the difficulties he had to surmount in order to record the new and interesting information which every step of his route presented him. In Nubia, though when he sought to write he always retired, he found it impossible to do so without being observed. At Mecca, the same difficulties presented themselves, as he could never be alone; and at Taif, his visits and occupations as effectually prevented it. It was thus with me in some measure; we were so closely and so agreeably occupied too, from sun-rise until midnight, that it seemed a sacrifice of time and pleasure to devote a moment to writing, worthy as the anecdotes we heard were of being preserved.

Jedda, Monday, December 5.

In continuation of his narrative, Ibrahim related to us his leaving Taif, and returning from thence to Mecca, after a stay of a few days only, and without possessing sufficient leisure to make any examination in person, or even to obtain much information from report relative to the town and surrounding country. His journey being merely a retracing of the steps he had already trodden, offered to his observation nothing new; and as the ceremonies he was obliged to perform both at Mecca, Arafat, and Munya, were such as is necessary to be gone through by all who visit the holy city on pilgrimage, I have endeavoured

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to give their connected and continued order in the following sketch.

The city of Mecca being surrounded by several fixed stations, in all the roads which lead to it from Jedda, Taif, Medina, and Derrayah, embracing nearly the four quarters of the compass, every pilgrim or traveller is compelled to halt there, and if not already thus arrayed, to throw aside his usual dress, and clothe himself in the Haram, as already described. On entering the city, his first duty is that of visiting the Great Mosque, kissing the black stone of the Kaaba, and walking round the building seven times; after which he performs his devotions in the Temple itself. From thence he has to walk, or rather trot, since it is a pace between walking and running, over a space of nearly half a mile, between the mosque and another fixed station, which is called Maraoot, and this also must be repeated seven times, after which he is at liberty to resume his ordinary dress, provided the period fixed by his vow is expired: for on putting on the Haram, a vow is necessary to be made, fixing the limits of the time it is intended to be worn, and before the expiration of that period, no man can put it off without committing a heinous sin.

Pilgrims arrive from different parts, by land and sea, at such various periods, that, while many are there for several weeks before the Hadj commences, and even pass their Ramadan there, others arrive only the day preceding it. It is on the eighth day of the moon Zeel-Hadj, which is the third moon after that of Ramadan, that all who intend to perform or repeat their pilgrimage, are obliged to leave Mecca, in the dress of the Haram, generally quitting the city at night, when, after five hours' travelling in a S. E. direction, they arrive at Mount Arafat on the morning of the ninth. Here they repose during the former part of the day, and at el Assr, or about three o'clock afternoon, assemble round the small hillock which bears that name, from the summit of which the Kadi of Mecca reads to the auditors from the Koran, while these are stationed on different parts of the hill, according to their separate sects of Hanafi, Shafi, Hanbeli, &c. Those occupying the places near the summit, turn their faces towards those who are near the base, and while the Kadi

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reads, they wave their handkerchief to each other, and exclaim, "O Lord God, there is none who divides with thee the government of the universe; and the world and all that it contains are subject to thy sole and unshared dominion."

At Muggrib, or sun-set, they all repair to a Mosque about an hour's distance westward of the hill, in imitation of the practice of Mahommed, who, they say, was accustomed to go from the Mount of Arafat to this spot to pray. Here they perform their evening devotions and sleep. On the morning of the tenth day of the moon which follows, they repeat in this Mosque their dawn and sun-rise prayers, and pick up from the ground on which it stands, seven small stones, about the size of a bean, which they wash and place in a corner of their handkerchief for security, journeying with them to the valley of Munya, about two hours' distance, in a south-westerly direction. Arrived at the valley, there is a small town or village of the same name, near to which are set up three square pillars built of stone, being about eight feet in height, and thirty or forty yards distant from each other, of very contemptible masonry and mean appearance, but highly venerated; and against the one of these nearest to Mecca, the seven small pebbles brought from the Mosque are thrown.

When this important duty is performed, the pilgrims return again to the valley of Munya, in which they say it was that Abraham offered up his son Isaac, and that his hand was stayed by the angel of heaven, who provided him a ram for the sacrifice, in commemoration of which event they purchase a lamb or a sheep, brought there in flocks by the Bedouins, and offer it up as a sacrifice, by slaying it on the spot, where they suffer it to remain, though it is soon afterwards taken from thence by the original proprietor, who finds the skin useful to him as a garment, and sells the flesh either at Mecca or elsewhere. The sacrifice completed, a portion of the hair is shorn, the Haram is thrown off, and the devotee is at liberty to resume his ordinary dress, which is done by the majority, and the remainder of the day is given to repose, the usual prayers being observed.

On the eleventh day of the moon, after morning devotions

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have been performed, seven other small stones are picked up from the ground near their tents in which they have slept, washed as before, and carried to the pillars, against the central one of which they are thrown, and this completes the duty of the day.

On the twelfth of the moon, they collect twenty-one of these pebbles, which are purified by washing them as before, when the pilgrim revisiting the pillars, first throws seven of them against the third, then another seven against the central one, and, lastly, the remaining seven against the first, deriving that distinction from its being nearer than the others to the holy city.

The ceremonies observed at Arafat and Munya, and, indeed, all the duties of the sacrifice, are thus finished, and the performer of them now returns to Mecca, resumes the Haram, walks seven times round the Kaaba within the Great Mosque, and kisses its black stone, and after his ablutions and prayers within the building, walks again seven times over the space without, which they call Maraoot.

To this succeeds immediately another duty, that of visiting the Hummahra, a small building situated at about an hour and half distant from Mecca toward the west, having two isolated pillars before it, at the distance of thirty or forty paces from the building, through which he must pass. At the Hummahra he prays, re-passes through the pillars, and returns to Mecca, exclaiming in the course of his route, "O Lord God, there is none who divides with thee the government of the universe; and the world and all that it contains are subject to thy sole and unshared dominion!"

At his return to the holy city, another visit must be paid to the Great Mosque, another seven times repeated circuit made of the Kaaba, and its black stone kissed, and another race be seven times run upon the space of Maraoot, after which the Haram may be finally thrown aside, and the pilgrim assume the name and character of a Hadji.

Women are permitted to perform their pilgrimage as well as men, which can only be rendered effectual or complete by their

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observing the whole of the journeys, prayers, sacrifices, &c., as before described, excepting only the use of the Haram, for which they must substitute a dress of their usual robes, the whole of them of a pure white, without the intermixture of other colours, and their faces to be closely veiled—added to which, they can only go as the companions of their husbands, who must be always near them throughout the whole ceremony.

Even children in a state of infancy, and of all ages upwards, are taken also to Mecca, by their parents, on pilgrimage, as infants are taken to the baptismal font of the Christian church, to make a profession of the faith by sponsors before they have arrived at an age of sufficient maturity to do it themselves. Children who cannot walk are thus carried to the Mosque, and borne round the Kaaba in their mother's arms, while their lips are pressed on the black stone to kiss it. Since they cannot utter their prayers, the father repeats them on their account. They are taken to Arafat, to the pillars of Munya, and to the valley, where the parent kills a number of sheep equal to those of his whole family, sacrificing also for each of those who are incapable of doing it for themselves.

* * * * * * * *

Jedda, Wednesday, December 7.

We breakfasted together for the last time; the caravan for Medina was decidedly to leave Mecca on Friday, as being the most favourable day for departure, in which both Turks and Arabs are as superstitious as any natives ancient or modern with whom they can be compared; and as some preparations were requisite before he commenced his journey from the holy city, Ibrahim's stay with us could not possibly be prolonged.

How much I felt indebted for the kindness of his visit to me, under such circumstances as must have occasioned him otherwise unnecessary fatigue and inconvenience, it is impossible for me to say; and the extreme and constant gratification which his short stay with us daily afforded, increased considerably the weight of an obligation, which the kindness of the act alone was sufficient to make me deeply sensible of.

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When he shook hands with us, in the moment previous to his descending the ship's side, there was a feeling of sorrow and dejection in each of the party, which expressed itself silently, but at the same time too plainly to be misunderstood. Captain Boog had become so warmly interested in his fate, as to be already bound to him by stronger ties than those of common intimacy; and for myself, it will be sufficiently explanatory of the sensations which passed within my own bosom to say, I felt as most men feel when they are parting from their longest-tried, their warmest, and their dearest friend.

Jedda, Wednesday, December 14.

We were visited to-day by a Turk of Baghdad, one of the passengers whom Captain Boog had brought with him from Bengal as supercargo of a portion of the ship's lading, the rest being under the direction of his fellow passenger, an Arab. Both of them had been at Mecca during the Hadj, under the hope of there selling the whole of the cargo, the vessel having been freighted expressly for the grand mart of commerce open at that city, during the assemblage of the pilgrims. They had, however, been extremely unsuccessful, first, from not having their goods upon the spot, and secondly, from a still more aggravating, because irremediable cause. To carry on his warfare against so active an enemy as the Wahabees, who fled with rapidity on their dromedaries across the deserts which separated them from the Turkish army, Mahommed Ali found it necessary to mount even all his infantry on camels, which with the number necessary for the immense quantity of baggage carried to the field by every common soldier, occasioned him to want a very extensive supply of these animals. Five thousand of them, purchased in Syria, and assembling in Egypt just before my departure from that country, had reached him by the land caravan through Medina; but these being insufficient, he had detained the Pasha of Damascus, who was here on Pilgrimage with about a hundred of his military attendants, and the whole of the Damascus caravan, amounting to more than another five thousand camels, as well as all the beasts from Baghdad, Persia,

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and Asia Minor, which were not absolutely necessary to the conveyance of the pilgrims to their respective homes; so that by this despotic measure all the beasts of burthen that had brought goods to Mecca, were seized for the war, and consequently there remained but few or none for the re-conveyance of other goods to their respective destinations; in consequence of which, neither purchases nor sales of heavy or bulky articles, requiring beasts of burden to convey them, could be afterwards effected.

Jedda, Tuesday, December, 20.

We were visited to-day by Othman Agha, the young Scotchman resident here, who brought us information, of our friend Mr. Burckhardt being still at Mecca, from which place he would not be able to depart until the tenth of the moon, a day of consequence with the Mahommedans, either as a religious festival, or as being more than ordinarily auspicious: for until that day, from some fixed period preceding it, the gates of the holy city were shut, and opened only to those who entered: the Pasha himself, with his court, having had his departure retarded until that day, so that it seemed as much an affair of compulsion, as of choice, in the observance. In a short note which Ibrahim had found an opportunity of writing to him in Arabic, he explained the cause of his unexpected detention to Othman thus. On his arrival there from Jedda, finding the caravan on the point of setting out for Medina, he lost no time in engaging camels for himself, and his slave which he had purchased at Mecca since his supplies of cash had reached him from Egypt, paying, as is usual in such cases, the price of their hire in advance. The beasts being engaged, he hastened to complete his other necessary arrangements, in the interval of which this Meccan Hadji, who had just completed his pilgrimage to the place of the Prophet's birth, and was now about to perform another to his tomb, gave a striking proof of the inefficacy of holy journeys in improving the morals of those who perform them, by escaping with his camel among the crowd, and boasting to his comrades of his successful deception. It was not without considerable difficulty,

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and the assistance of others, that this swindling pilgrim could be apprehended, when he was taken by Ibrahim before the Kadi, and as he made no scruple of confessing the fact, was made to refund the money,; expressing his regret, not at the action itself, but at not having taken greater precautions to prevent his apprehension. This detention, therefore, lost them both the caravan.

Jedda, Sunday, December 25.

We remained at Jedda, detained by the affairs of commerce and the transactions relating to the ship, when the following letter was brought by a messenger from the Holy City, one of the ship's company, to whom the Captain had given leave, with many others, to go up to Mecca and perform the duties of their religion.

Mekke, Mohurrum 11, 1230.

My Dear Sir,

The cabin-boy of the Rasool very unexpectedly gave me his Salam Aleikum this morning in the Bazar, and when I treated him as a runaway, produced the boatswain and a third comrade to prove that they had all come here with Captain Boog's leave. My judgment was over-ruled by such respectable witnesses, and as they told me that they intended to return to Jidde this evening, I thought I might safely trust them with these lines, the purpose of which is merely to tell you that I am well, that the caravan does not move yet, and that I infinitely regret to have lost all this time, since I might else have spent it in your's and Captain Boog's society.

The troops are all here with the Pasha, who is exclusively occupied at present with the transport of provisions to Taif. The horsemen stationed at Taif have made some successful incursions towards the East and South, and brought home about 8,000 sheep; but no battle of consequence has taken place. The Pasha reserves the fame of a doubtful victory to himself.

Among the various nations and sects resorting to Mekke during the Hadj time, is a sect of Indian Mussulmans called

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Ismaylis, men of property, who come from Surat, but whose country is in the interior of the Peninsula. They sell here corallines, false pearls, China ware, *&c.* It is well known that they are no true Mahommedans, although they are very strict in the performance of prayers and religious rites, and it is generally supposed that they are Pagans. They live altogether in a large house, where they admit no other lodgers, never bringing any females with them, although twenty or thirty arrive here every year; and many have been known to live here for ten years without marrying, which is much against the customs of this country. During my stay in the mountains on the North of Mount Libanus in Syria, I got acquainted with the sect of Syrian Ismayles, who likewise profess Mahommedanism, but are well known to be Pagans, and I heard it once said *en passant* in an evening Society of Christians at Hamah, that the Ismayles have their principal temple in the East Indies, and send every year by way of Baghdad one of their followers with presents to that holy shrine. The Syrian Ismayles practise yearly feasts of Venus, when they mix in nocturnal embraces with their nearest friends, parents, and relations.

I should be much obliged to you if you would have the kindness, upon your arrival in India, to make some inquiries as to the *seat* and *religion* of these Ismayles, and whether it is known there that they are in relationship with their Syrian brethren. An Indian Ismalee might perhaps be prevailed on to make some disclosures to an Englishman, which a Syrian Ismaylee would never make to an inhabitant of his country; and to get some true information respecting this singular sect would be extremely interesting.

This is perhaps the last letter you will ever receive dated from Mekke, and I ought therefore to make it a long one, but I have really nothing to tell you of immediate interest, and the boy comes this moment to ask for the letter. Therefore, farewell, my dear Sir; may your hopes be realized, may your good fortune enable you to provide for your dear family in Indian climes, and may we once meet again both satisfied with the result

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of past time and labour. Wherever fate carries you, remember, I beg you, an honest Swiss, who reckons himself among the most sincere of your friends.

HADJ IBRAHIM.

Give my best compliments to Captain Boog, the memory of whose friendly hospitality and conversation will certainly never be forgotten by me, and if you write to me from Bombay, do not fail to give me of his news——Remember Rennell's Herodotus and Seetzen's fate;—Written in haste, with a reed.

These last requests of Mr. Burckhardt regarding the Indian sect of Mussulmans, called Ismayles, the illustration of an interesting portion of Rennell's Herodotus, and an inquiry into Dr. Seetzen's fate, have all been scrupulously executed. They were the requests of a man who possessed an ardour in the pursuit of his objects, which made him in earnest in all that he ever did or said; and they were made to one who, like himself, would have prosecuted such inquiries for their own sake, but who had an additional motive to actuate him, in the friendship which he entertained for the excellent individual who proposed them.

The inquiry regarding the Ismayles was not so satisfactorily answered as had been hoped for, since the same mysterious secrecy as Mr. Burckhardt himself complained of in his intercourse with the Ismayles of Mecca, has been found by the inquirer to prevail in an equal degree among those of India. The short notice of them which was drawn up, however, and ransmitted to Mr. Burckhardt, has been preserved.

The portion of Rennell's Herodotus, which Mr. Burckhardt was desirous of having illustrated by the person to whom he wrote, was the Chapter on Babylon, of which it was probable this person might have an opportunity of examining the remains. This expectation has been realized, and the observations to which it gave rise have been incorporated with a larger work,

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and could not well be condensed into a form calculated for a Journal like our own.

The inquiry into the fate of Dr. Seetzen, was made at Mokha, where he met his death, and the letter sent to Mr. Burckhardt from thence, containing the result of these inquiries, was transmitted to Vienna for the information of his illustrious patrons, the Emperor Alexander and the Duke of Saxe-Gotha, and was afterwards inserted in the *Mines De l'Orient*, a work published at the Austrian capital. As we possess this notice in its original form, and the *Mines De l'Orient* is a work not in general circulation, we shall incorporate with it such other notices as we possess of the travels of Dr. Seetzen, and present them to our readers, with the account of the Ismayles, both of which were drawn up from very authentic sources, and may therefore, after having served the purposes of private friendship, be found worthy of being more generally known.

To return to the subject of this memoir. He journied from Mecca to Medineh as he intended, and the writer of the Journal quoted, received an exceedingly interesting letter from him while in that city of Arabia, dated from beside the Prophet's Tomb, and descriptive of the town and the holy wonders it contained. The original of this letter has been sent to England, and the copy of it mislaid. From Medineh he intended to have gone by Arabia Petræa, and round the Gulf of Aila, by Eloth and Ezion Gaber, of the Scriptures, into Egypt, but this project was defeated by the appearance of the plague at Medineh, which induced him to come down to Yambo on the sea coast, and embark from thence for Suez. After a short stay in Cairo he made his last excursion from thence to Mount Sinai, and the Desert of Wandering, as those wastes around Horeb are generally called. His journal of this interesting tour has reached England. It is interspersed, with a variety of historical notices on the former state of the country, and annexed to it is a memoir of the wanderings of the Israelites on their departure from the land of Pharaoh.

From this period Mr. Burckhardt remained in Cairo until the

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moment of his death, and the writer of the journal had the happiness of meeting him there in the winter of 1815, when his ardent mind was firmly bent on its purpose of traversing the whole continent of Africa, and solving the problems of the outlet of the Niger, and the hidden sources of the Nile, and his hopes of success were so high as to amount to confidence.

The Journal enumerates some of the works which Mr. Burckhardt had collected in Arabic literature, and, it is said, that the Association for which he travelled had in their possession a variety of notices on the interior of Africa, with several vocabularies of African languages, collected from the natives who visited Egypt during Mr. Burckhardt's detention in that country.

Such are a small part of the labours of this extraordinary person, whose accomplishments and perseverance were such as could not have failed, had he lived, to place him high in the ranks of the most distinguished travellers of this or indeed any age. He has, in fact, left behind him materials which have scarcely ever been equalled by any of his predecessors for the interest and importance of the subjects, the extent of his observations, and for the elegance even of his style, though written in a foreign idiom.

The close of Mr. Burckhardt's last work, we understand, is brought down to the 25th March, 1817, when the approaching summer seemed to offer to him the pleasing prospect of a caravan destined to Mourzouk, a route which he had long before decided on as the most likely to conduct towards that point which had now for many years been the principal object of his life. His expressions on this occasion, and which we copy from one of the last letters he was destined to write, cannot be contemplated, at the present moment, without feelings of deep regret.

'I write to Sir Joseph Banks, and repeat to you, that I am in anxious expectation of a caravan from Libya, and I have been long prepared to start on the shortest notice. I shall leave Egypt with more pleasure, because I shall now no more have to regret leaving my journals in a rude state, which would have been the case if I had started last year; and it will afford me no small consolation upon my future travels, to think that, what-

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ever may be my fate, some profit has, at least hitherto accrued from my pursuits, and that the Association are now in possession of several journals of mine, treating of new and interesting countries.'

Such was the eager and lively hope with which he looked forward to joining the departing caravan! but Providence ordained otherwise. On the 5th of October 1817, he was suddenly seized with a dysentery, which, in spite of the attendance of an English Physician, hurried him to an untimely end on the 15th of that month. No words can better depict the last moments of this object of our regret, his ardent mind and his affectionate heart, than those of the letter from the consul-general of Egypt to the secretary of the African Association, alluded to at the beginning of this article.

ART IV. *Observations on the Medico-Chemical Treatment of Calculous Disorders. By* WILLIAM THOMAS BRANDE, Sec. R.S. *&c. Continued from page* 209 *of* Vol. VI.

Section 2. *On the Production of Calculi in the Kidneys, their Nature and Treatment.*

HAVING endeavoured in the first Section of this Paper to point out the principal circumstances connected with the early symptoms of gravel, and with their treatment, I shall now endeavour to give some account of what may be called the second stage of the disease, or that in which the materials are voided in an agglutinated form, so as to constitute small calculi, or *gravel*, limiting the term *sand* to the earlier stages. It generally happens that the formation of gravel is preceded by one or more attacks of sand, and that concretion is prevented by due precaution in that earlier stage of the disorder; but this is by no means always so, for not unfrequently the first alarm of the patient is occasioned by his voiding a calculus, and that of no small size.

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The calculi formed in the kidney, and voided without remaining any considerable time in the urinary passages, are either uric, oxalic, or cystic. It is difficult to assign a reason why the phosphates never concrete so as to form small kidney calculi: but I have never as yet seen an instance of this kind; for in three instances in which concretions, consisting of ammonio-magnesian phosphate were voided, they were solely of bladder origin, and appeared to owe their formation to disease of the prostate gland in two cases; and in a third were fragments of a larger calculus rounded by attrition in the bladder.

The uric calculi, as voided immediately from the kidney, are of a yellowish or reddish brown colour, somewhat hard, soluble in caustic potash, exhale the smell of burned horn before the blowpipe, and when heated with nitric acid, produce the peculiar red compound which Dr. Prout has called rosacic acid.

The oxalic calculi vary considerably in appearance. They are generally of a greyish brown colour, and made up of numerous small cohering spherules: sometimes they have a polished surface, and resemble a hempseed. They are easily recognised by their insolubility in dilute muriatic acid; and by their behaviour under the blowpipe, where they swell up, and burn into a white ash, consisting of pure lime.

The cystic calculi have a yellowish colour, a crystallized appearance, and are soluble in dilute muriatic acid, and in diluted solution of potash. When heated in the flame of a spirit lamp, or by the blowpipe, they exhale a peculiar fetid smell, which, as Dr. Wollaston has remarked, is singularly characteristic of this species.

With respect to the relative frequency of these calculi, the first are by far the most common; the second are not rare, and the third of unfrequent occurrence. Out of 58 cases of kidney calculi, 51 were uric, 6 oxalic, and 1 cystic.

The treatment of kidney calculi may be divided into general and particular. The former applicable in all cases; the latter dependant upon the chemical nature of the concretion.

As a full and nutritious diet, and the daily use of fermented liquors, tend, independent of other causes, to increase the

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specific gravity of urine, and consequently to render the separation of its solid contents more likely to occur, they should on that account only be avoided; but when conjoined, as they often are, with sedentary habits, the powers of the digestive organs become impaired, there is more or less habitual costiveness, and a corresponding change in the secretion of the kidneys, by which it is rendered more prone to sabulous deposits, always ensues. Hence it is, that writers on the present subject have properly advised plain food, moderate exercise, and abstinence from fermented liquors; it is also I think right, in most cases, to enjoin the liberal use of aqueous drinks, by which the urine becomes diluted, and consequently will have less tendency to form any deposit.

But all experience shows, that whatever deranges the stomach and bowels, and the other organs concerned in digestion, more especially the liver, produces corresponding mischief in all these calculous cases; hence the apparent success of very opposite modes of treatment, and the probability that calculus is in many instances to be considered as a symptomatic disorder; and hence also the beneficial effects of mild aperients, tonics, bitters, *&c.*, and the great advantage of moderate horse exercise, where it is not forbidden by irritation in the kidneys. There can, on the other hand, be little doubt, that violent exercise may, for many reasons, be prejudicial; and, among others, by occasioning profuse perspiration, which carries off a portion of water by the skin, that would otherwise have passed through the kidneys.

Of the calculi which we are now considering, those formed of uric acid are, as I have already observed, by far the most frequent; and it is of this substance that the calculi retained in the kidney, and filling the infundibula and pelvis, and often increasing to such a size as to obliterate a great portion of the glandular structure, are almost exclusively formed; hence it is always an object to obtain the expulsion of a calculus from the kidney as soon as possible, and to prevent its increase.

The symptoms of kidney calculus are of very different shades of violence, and sometimes so trifling, that little is suspected

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till the stone is voided; and that the formation of a stone in the kidney is not necessarily attended by any leading symptoms, is proved by the numerous cases in which they have been discovered after death in those viscera, without any mischief having been suspected during the life of the patient; of this a very remarkable instance is related by Dr. Marcet, in a patient who died of hydrothorax, and who never complained of any affection of the urinary organs, but whose kidney was distended by a large collection of calculi.

But acute pain almost always attends the passage of a calculus along the ureter, and when this is followed by the expulsion of small grains of red sand in the urine, the nature of the disease is sufficiently distinguishable from mere inflammation. There is, however, seldom much diagnostic difficulty, for the cases are very rare in which a calculus has made its way from the kidney to the bladder, without sufficient warning; and we usually hear of a sense of weight in the region of one of the kidneys, succeeded by an obtuse pain of the part; the urine is described as high coloured, and depositing a reddish sediment, then comes the acute pain of the passage along the ureter, generally attended by numbness of the thigh on the same side, and of very variable duration; this is succeeded by a period of ease, which lasts either till symptoms of stone in the bladder come on, or till the calculus enters the urethra: at this period every means should be resorted to, that tend to the expulsion of the stone, for as will afterwards be shown, the longer it remains in the bladder the less likelihood will there be of getting rid of it. Large quantities of aqueous drinks, and other mild diuretics, should be resorted to, and the greatest benefit is frequently derived from purgative medicines, the best of which in these cases is the sulphate of magnesia, dissolved in a large quantity of warm water, or the same salt with infusion and tincture of senna.

While on this subject it is necessary to bear in mind, that a small calculus may lodge in the membranous part of the urethra, and gradually enlarge there in consequence of the de-

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position of new matter by the passing urine, until it has acquired a very considerable size. In the fourth section of my Paper, on the differences in the structure of calculi, I have noticed three cases of this kind, of which the specimens are preserved in the museum of the College of Surgeons. Dr. Marcet (Essay, p. 9.) has also described a similar case, in which the stone was mistaken for a stricture, and of which a representation is given in the fifth plate of his work.

Among the most common general symptoms of kidney calculus is the production of a large quantity of mucus, which is often streaked with blood, and sometimes of a purulent aspect. A considerable hæmorrhage too not unfrequently attends the passage of a stone into the bladder.

Such are the chief symptoms that attend the production of a calculus in the kidney, and its passage into the bladder, and they naturally call for certain plans of general treatment which it is not my business here to dwell upon, but which principally relate to allaying irritation and mitigating pain, as by opium; by henbane, which is often a most useful medicine, operating as a diuretic narcotic, without producing costiveness; by the warm bath; by frictions upon the loins by external irritants, excepting always cantharides; by suppositories or injections of opium: I have heard tobacco infusion recommended also as an injection, but should suspect it of mischievous rather than good effect.

Much of what might have been said respecting the particular treatment of kidney calculi has been anticipated in my former observations, "on the early Symptoms of Gravel, and on the modes of treating them;" but in the present instance, more promptitude and judgment is required, in consequence of the risk now incurred of the lodgment or formation of a calculus in the bladder.

The majority of cases, as I have already remarked, are *uric*, while kidney calculi, properly so called, composed of the phosphates exclusively, are of extremely rare occurrence: accordingly, having attended to all that relates to the passage and expulsion

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of the calculus, if we find it composed of uric acid, those means must be adopted that I have endeavoured to explain, in speaking of *uric sand.* (Page 204, Vol. VI. of this Journal.) Carefully observing the importance of pursuing the alcaline system to a certain extent only, and not erroneously persevering in it as a preventive, after the desired effect of removing its excess in the urine has been attained. The dull pain that remains in the region of the kidney, after the formation or passage of a small calculus, is not, as far as my experience goes, to be considered as symptomatic of the lodgment of calculous matter; it is generally relieved by cold bathing, and, in more than one case, I have observed electricity of considerable service; when, however, it is attended by nausea, sickness, shivering, and pain or numbness of the thigh, the retention of calculous matter in the kidney may be justly feared, and in this species of calculus a relapse is always to be apprehended.

It is a difficult point to determine the particular treatment applicable to oxalic calculi, but it fortunately happens that they very seldom occur; and as oxalic sand is not voided at the time of their formation, we are not able to judge of the cause of the mischief, till the effect has become evident. I have memoranda of nine cases of the voiding of oxalic calculi, and in one only has there been a second attack, after an interval of two years; in one instance a second stone was voided three days after the first, but it had probably lodged in the bladder, and was of coeval formation with that which first passed.

Two instances of cystic oxide voided as a kidney calculus, have come under my own observation, and I have neither seen, nor heard of any other. In one, the calculus was voided by a labourer, and was sent to me with no particulars of the case, nor have I since been able to obtain them. In the other, several of those calculi, varying in size from a pin's head to that of a pea, had been voided at different times during a period of thirty years, by a gentleman forty years of age; he had been subject from the age of six or seven years to pain in the region of the loins, not confined to any particular spot, and seldom of any acuteness, or such as to prevent his ordinary occupations, which

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obliged him to lead rather a sedentary life; his usual state of health was good, his habits very regular, his diet ordinary and plain; he had used soda water, magnesia, and the alcalies, without any advantage; I proposed he should try a mild acid plan, and pointed out to him the requisite precautions that should be adopted to prevent the retention of a calculus in the bladder, but I have not been sofort unate as to learn any further particulars respecting this gentleman, who is resident in Ireland.

There are many circumstances connected with the history of kidney calculi, which I have not adverted to, either for want of practical information upon the subject, or because I shall have a preferable opportunity of recurring to them in the observations I have yet to make on calculi of the bladder.

ART. V. *Some Observations relating to the Agency of Galvanism in the Animal Economy, in a Letter addressed to the Editor of the Quarterly Journal of the Royal Institution.* *By* A. P. Wilson Philip, M.D., F.R.S.E. *&c.*

Worcester, July 22d, 1819.

SIR,

As you were so good as to publish, in the last Number of the *Quarterly Journal,* my reply to a Paper in a former Number of that work, in which the accuracy of certain experiments, detailed in my *Inquiry into the Laws of the Vital Functions,* is called in question; I take the liberty of transmitting to you some observations on the subject of these experiments. If they appear to you to deserve a place in the above Journal, you will oblige me by inserting them.

While the writers who have done me the honour to notice my inquiry, have admitted the accuracy of the other inferences, those from the galvanic experiments have, by some, been called in question. I have carefully considered what has been brought against them, without being able to perceive its force. I cannot help ascribing it, in some degree, to the novelty of the subject, and to the circumstances which originally induced me to trouble you; from which it appears, that some who must be supposed

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well versed in medical science, in the first instance objected to these inferences. I also, in some degree, ascribe it to the arguments relating to this part of the subject being necessarily dispersed through a great part of the treatise, even in the last edition, in which I have endeavoured, as far as was consistent with the general arrangement, to bring them into one view. This prevents their being fairly considered, except at the expense of much trouble. The object of the present pages is to communicate to the reader what I have attempted to ascertain respecting the agency of galvanism in the animal economy, in a concise and more connected form, and consequently one which affords less room for misconception.

Some, who will not admit that any argument in favour of the identity of the nervous influence and galvanism can be derived from the experiments in question, allow, that they prove the latter to be capable of acting as a substitute for the former. This language, I confess, I do not understand. Whatever is capable of acting as a substitute for the nervous influence, must possess its properties. I have said, that such and such are the properties of this influence, and that galvanism, possessing all these properties, we have reason to regard the two powers as identical. To refute this inference, it must be shewn, that I have mistaken the properties of the nervous influence, or that galvanism does not possess these properties, or possesses others inconsistent with those of the nervous influence. Although all will grant the truth of this position, yet in no instance do those, who, admitting the accuracy of the experiments, controvert my inference from them, attempt to prove that in any of these respects I have been misled. They satisfy themselves with assertions, that my conclusions in this part of the subject are less correct than in others, that it is still involved in obscurity, *&c.* Without regarding general assertions of this kind, which, it is evident, unless they are the legitimate result of a fair statement of facts, amount to nothing, let us endeavour to ascertain how far our present knowledge enables us to go towards determining the question before us.

I have endeavoured to shew that the functions of the nervous influence are those of conveying impressions to and from the

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sensorium, of exciting the muscular fibre, of separating and recombining the elementary parts of the blood in the formation of the secreted fluids, and of causing an evolution of caloric from the blood.

That the nervous influence is the means of conveying impressions to, and from, the sensorium, will not be denied.

That it acts merely as a stimulus, without bestowing any power on the muscular fibre, appears from the thirty-second experiment of the above-mentioned *Inquiry*, which shews, that an artificial stimulus more quickly exhausts the excitability of this fibre, when it is exposed at the same time to the operation of the nervous influence, than when it is exposed to the effects of the artificial stimulus alone.

That the nervous influence is an agent in the formation of the secreted fluids, we learn from experiments which shew that when this influence is withdrawn from the lungs and stomach, these organs in all other respects remaining in the same state, their secretions are deranged. Fluids, indeed, are still deposited in their cavities, and apparently as copiously as before; but these fluids no longer undergo the proper change. Those of the lungs assume an appearance differing little from that of the sanious discharge from some kinds of wounds. The fluids of the stomach, we know, are no less altered, because they no longer make any impression on the food. These facts do not rest on the accuracy of my experiments alone, as many of my opponents seem to imagine. They were long ago pointed out, as stated in the above *Inquiry*, by the experiments of Haller, and other Physiologists of the first name. I only add my testimony to theirs in proof of them*. It appears, then, that the nervous influence is necessary to the function of secretion. It either bestows on the vessels the power of decomposing and recombining the elementary parts of the blood, or effects those changes by its direct operation on this fluid. From many facts stated or referred to in my *In-*

* My *Inquiry into the Laws of the Vital Functions*, Exper. 44, 45. See also Exper. 54, 55, 56, 57, 58. The page and number of the experiment referred to in the following paper are those of the second edition of the *Inquiry*.

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quiry it appears, that the vessels possess no powers but the muscular and elastic; and that the former, as well as the latter, is independent of the nervous system*; nor is it possible to conceive any modification of these powers, by which they could become chemical agents, and thus be enabled to separate and recombine the elementary parts of the blood. The first of the above positions may, therefore, be regarded as set aside; and the necessary inference seems to be, that in the function of secretion, the vessels only convey the fluids to be operated upon by the nervous influence.

That the evolution of caloric is effected by the state of the nervous influence, appears from many experiments. Mr. Brodie has shewn that in proportion as the action of the brain is debilitated, the evolution of caloric is lessened †; and it appears from experiments which I have laid before the public, that lessening the extent of the nervous system, by destroying portions of the spinal marrow, has the same effect‡. But it also appears from a great variety of facts, that its evolution depends equally on the state of the blood. It is needless to enumerate the various phenomena of the living animal which support this position, with which every Physiologist is familiar; but it may be proper to observe, that I have found by many experiments§, that if the circulation be supported by artificial respiration in the newly dead animal, an evolution of caloric continues to take place, which is not found to be the case when the circulation is allowed to cease. Thus we see that the evolution of caloric in the animal economy depends equally on the state of the nervous influence, and that of the blood, and, consequently, like the formation of the secreted fluids, arises from their joint operation. On this account I have said, "If caloric be admitted to be a substance, its evolution from the blood being effected by the same means by which the secreted fluids are formed, it must be regarded as a secretion;"

* Exper. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 31, 32, and the observations under Exper. 32.

† *Croonian Lecture* for 1810, and *Philosophical Transactions* for 1812.

‡ The above *Inquiry*, Exper. 54, 55, 56.

§ The above *Inquiry*, Exper. 64, 65, 66, *&c.*

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this view of the subject appearing best calculated to convey an idea of the manner in which its evolution takes place. I know of no definition of the term secretion, as applied to the matter secreted, but a *tertium quid* produced by the action on each other of the nervous influence and the blood.

Such is a cursory view of the proofs that the functions of the nervous influence are those above stated, namely, to convey impressions to and from the sensorium, to excite the muscular fibre, to separate and recombine the elementary parts of the blood in the formation of the secreted fluids, and to cause an evolution of caloric from the blood. We are now to inquire how far galvanism is capable of these functions.

That galvanism is capable of passing along the nerves both to and from the sensorium, and therefore of conveying impressions in either direction, will not be questioned.

It will also be admitted, that it is not only capable of acting as a stimulus to the muscular fibre, but that, with the exception of the nervous influence itself, we know of no other agent which possesses this property in so remarkable a degree.

With regard to the function of secretion, that galvanism is capable of decomposing and recombining the elementary parts of the blood in precisely the same way in which they are decomposed and recombined by the nervous influence, if applied to that fluid under the same circumstances, appears from experiments related in my *Inquiry**, which were not performed in private, but in the presence of many competent witnesses; and not by me alone, but by others in my absence with the same results.

That galvanism is capable of causing an evolution of caloric from arterial blood, that is blood which has not already undergone the secreting process, appears also from experiments related in the same *Inquiry*†.

It is further shewn in that *Inquiry*, that in the human body itself, galvanism can be made to perform the functions of the nervous influence. In apoplexy, for example, where we see, from the failure of this influence, the function of the lungs im-

* Exper. 70, 71, 72, 73. † Exper. 76, 77, 78, 79.

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peded, and their fluids accumulating in the air-cells and bronchiæ till they produce suffocation, as happens where these organs are deprived of their nervous influence by dividing their nerves, we find the galvanic power restoring their free action, and maintaining it as long as sufficient sensorial power remains to enable the patient to inhale with sufficient frequency for the performance of the functions of respiration*. In other instances, we see the same agent restoring due action to the digestive organs, as well as to the lungs, where we have reason to believe a failure of their nervous influence had produced disease†.

If such be the facts, it will be difficult to deny the identity of the nervous influence and galvanism, unless it can be shewn that the latter possesses some property inconsistent with the nature of the former. Should this be found to be the case, would it not be extraordinary that a power, wholly distinct from the nervous influence, should be capable even of its most complicated functions? How anomalous would this fact appear! Is it possible to find any thing analogous to it in any other department of knowledge? But this is far from being the case. The more we study the phenomena of the nervous influence and galvanism, the more striking the analogy between them appears. We see in the animal economy a constant succession of the most complicated chemical changes. Why should it surprise us, that what appears from every fact on the subject to be the most powerful of all chemical agents which we know to be universally diffused, and which, it must be allowed, many observations led us to believe intimately connected with the animal economy, should be the agent in these changes?

Were it not for opinions unaccountably ascribed to me, I should think it superfluous to add, that I have never regarded galvanism as having any thing in common with the sensorial and vital powers, as I have explained in the first, and still more fully in the second edition of my *Inquiry*. I only maintained, that we have reason to believe that the nervous influence which I had, with much pains, and the assistance of many experiments, attempted to define, shewing that it survives the sensorial power,

* See the first chapter of the third part of the above *Inquiry*.

† See the fifth chapter of the third part of the above *Inquiry*.

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but is wholly incapable of its functions after the extinction of the vital principle, is a chemical agent; and that it is the same which operates in many similar phenomena, which we know to be the effects of galvanism. Is any thing required to try the validity of these suggestions, but to ascertain whether galvanism is capable of the functions of the nervous influence?

Allow me to extract from the second edition of my *Inquiry into the Laws of the Vital Functions*, the following passages:

"When we say that we are acquainted with the cause of any particular set of phenomena, we only mean that we know them to arise from the same cause, which produces other more familiar phenomena. Thus we are acquainted with the cause which retains the planets in their orbits, because Sir Isaac Newton proved it to be the same which produces the other phenomena of gravitation. We are acquainted with the cause of lightning, because Dr. Franklin proved it to be the same which produces the other phenomena of electricity. Can we shew that the phenomena of any or all of the foregoing vital powers depend on the same cause which operates in the production of other phenomena?

"With regard to the sensorial power, it seems to require but a moment's reflection to answer this question in the negative. There is no real analogy between the effects of this power, and the phenomena observed in any other part of nature. Certain fanciful analogies of this description have, indeed, from time to time been suggested; but while they have pleased in the writings of the poet, by the philosopher they have been justly rejected. To a careful observation and judicious arrangement of the phenomena of the sensorial power therefore, our study of it must be confined.

"With regard to the nervous power, the case is very different. The principle which operates in many other instances may be the means of exciting the muscles, of conveying impressions to and from the sensorium, of effecting the formation of the secreted fluids, and of causing an evolution of caloric from the blood." Page 221, 222.

"With regard to the vital principle itself, we may say of it what is said above of the sensorial power. As its effects cannot

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be classed with the phenomena observed in any other part of nature, we have no reason to believe that we shall ever be able to refer them to any more general principle.

" Whether the vital principle be something superadded to bodies, or only a peculiar arrangement of their constituent parts, the fact is, that it bestows on matter certain properties, (in consequence of which, neither mechanical nor chemical agents produce the same effects on living, as on inanimate, matter.) It is essential that our expressions should convey this fact, *and no more.* The galvanic experiments which have been laid before the reader go far to prove, that galvanism has nothing in common with this principle, because these experiments exhibit them acting parts in the animal economy wholly of a different nature.

" I here wish particularly to state what, although fully expressed in the first edition of this Treatise, has yet been overlooked by some in alluding to my opinions, that the effects observed from galvanism in the above experiments, are its effects on parts endowed with the vital principle, wholly ceasing, and by no means renewable when this principle is extinct. Galvanism seems capable of performing all the functions of the nervous influence in the animal economy, but neither the nervous influence nor galvanism can excite the actions of animal life, except in parts endowed with the vital principle. Parts endowed with this principle collect the nervous influence and apply where it is wanted, to act on parts also endowed with the same principle; but the nervous influence itself seems to be nothing more than that influence, which operates in the production of all galvanic phenomena." Page 248, 249.

" It would appear from these observations, that the nervous influence, or galvanism, in exciting the muscular fibre, as in the formation of the secreted fluids, and the evolution of caloric from the blood, operates by effecting a chemical change. Thus the phenomena of the nervous power seem to be only another field in which galvanism exhibits those striking chemical powers which we have seen it display in other instances." Page 250.

It will place what has been said in a clearer point of view, if I present to the reader a concise statement of the principles

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on which the division of the functions of the animal body into sensorial, nervous, and muscular, adopted in my *Inquiry*, is founded.

With regard to the last, I have already had occasion to refer to the experiment, which appears to prove the separate and independent existence of the power on which the muscular function depends*. It will be necessary to speak more at length of the others.

It appears from many experiments, that after the operations of the sensorial power can no longer be observed, that is, after all signs of sensation and voluntary power finally cease, and the animal is what we call dead, it is not immediately reduced to the state of inanimate matter. Some of the vital powers for a certain length of time survive. It has long been known that, in the newly-dead animal (the term dead I shall employ in its usual though not very correct acceptation,) the nerves are still capable of conveying impressions to the muscles, and the muscles of performing their function; so that the action of the latter may still be excited, by dividing or bruising the former. It appears from experiments laid before the reader in the above *Inquiry*, that the nerves also still possess the power of decomposing and re-combining the elementary parts of the blood†, and also that of occasioning an evolution of caloric from this fluid‡.

The foregoing powers, then, surviving the sensorial power, are independent of it, and of the causes which maintain its existence in the animal economy. They also differ essentially from the sensorial power in another respect, that most of them evidently are, and all of them may be, the operation of a chemical agent, acting on parts endowed with the vital principle; while the sensorial functions, sensation and volition §, are of a nature

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* Exper. 32, and the observations after this experiment.

† Exper. 61, 62, 63.

‡ Exper. 64, 65, 66.

§ I speak only of the sensorial powers essential to the life of the animal. The others are equally distinct from the effects of any chemical agent, but they form no part of the object of this paper. See the above *Inquiry*, page 206, et seq.

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which has nothing in common with the effects of any chemical agent. We also perceive, during life, a well-marked line of distinction between these two sets of functions. While the animal enjoys health, the sensorial functions are subject to intervals of inactivity. In the most perfect sleep, these functions, with the exception of that part of them which is necessary to respiration, cease; while the functions which I have termed nervous, on which, in conjunction with the muscular function, the life of the animal depends, have no such intervals; and, by their constant activity, support that part of the sensorial functions with which they are intimately connected in respiration. This is the only function, as appears from what is said in the tenth chapter of the second part of my *Inquiry*, essential to life, in which the sensorial power is concerned, and which, consequently, forms the only connexion essential to life, between the sensorial and nervous powers.

The extent and nature of this connexion I have endeavoured to define by many experiments, which demonstrate the independent action of the sensorial and nervous, as well as the muscular power, in the function of respiration*; shewing that, although they all conspire in its performance, so that it ceases if any one is withdrawn, yet that, after withdrawing any one, we can still prove by experiment the presence of the others in unimpaired vigour†, although rendered ineffectual, as far as relates to respiration, by the absence of a power, which must co-operate with them in this complicated function.

These observations led me to point out, that, as the sensorial powers are always the first whose operation ceases in dying, unless death be instantaneous throughout the system, by the sudden and total destruction of the nervous power‡ it is by destroying respiration, that all other causes of death finally destroy the nervous and muscular powers§. These powers can-

* See the Tenth Chapter of the Second Part of the above *Inquiry*, and the experiments there referred to.

† See page 210, et seq. of that *Inquiry*.

‡ Ib. page, 213 et seq.

§ Ib. page 206, et seq.

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not *long* exist after respiration ceases, because the blood then no longer undergoes the necessary change in the lungs; but we still find them *for some time* remaining in every part of the system; and, if respiration be artificially supported, imperfectly as it is in our power to effect this, we can perceive unequivocal proofs of the continuance of all the functions of the nervous, as well as muscular power, except of course that it can no longer impress the sensorium, nor receive impressions from it where no sensorium exists *. It gives evidence of its power still to convey impressions along the nerves, however, by its still conveying those which excite the muscles.

Such is the foundation for the division which I have adopted of the functions of the animal body into sensorial, nervous, and muscular; and unless the facts here referred to can be controverted, I cannot perceive how it is possible to deny, that each of these classes of functions is supported by a power which may exist separately, and consequently can have no direct dependence on the powers which support the others.

It appears from what has been said, that the circumstances which form the line of distinction between the sensorial and nervous functions may be referred to three heads: 1st, The latter still continuing in the newly dead animal. 2d, Their being such as either evidently are, or may be, the effects of a chemical agent, while the sensorial functions have nothing in common with the effects of such an agent; and lastly, the sensorial power being subject to intervals of inactivity in the healthy animal, while the vigour of the nervous power is permanent. It is true, that two of the functions of this power have intervals of rest, namely, those of conveying impressions to and from the sensorium, and of exciting the muscles; but they only suffer these intervals, because they are operations of the sensorial and nervous powers jointly, and consequently fail when either of these powers fails. Those nervous functions which depend on the ganglian system, the formation of the secreted fluids, and the evolution

* Exper. 61, 62, 63, 64, 65, 66, 67, 68, 69.

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of caloric*, and are independent of the sensorial power, are permanent†.

The greatest difficulty, perhaps, to be encountered in defending the identity of the nervous influence and galvanism, arises from the former having been very generally regarded as part of the sensorial power. If the nervous power is once admitted to be merely a chemical agent, the question assumes a very different character. It has not been unusual to regard the sensorium as pervading, by means of the nerves, the whole system, and to suppose that we actually feel in the parts to which we refer our sensations. But a moment's reflection shews the inaccuracy of such a position. It is evident, that either this must be the case, or that there must be some centrical part to which the power of sensation is confined, and to which all impressions causing it are conveyed, a knowledge of the relative position of the part impressed being the result of experience. By disproving either of these positions, therefore, the other is established. Various ways present themselves of disproving the first. I shall confine myself to one, because it appears to be conclusive. When we complain of the toes of a limb which has been amputated, the cause of sensation cannot be in the toes. Here we see irritation of the stump of the nerve producing the same effect on the sensorium, which used to arise from irritation of its extremities. Many similar instances might be mentioned. We cannot shew why the immediate cause of sensation should so exist in these cases, and not in all. The sentient organ, therefore, is confined to a centre, to which all impressions, causing sensation are conveyed. It is thus that infants cannot distinguish the parts of the body impressed. This power is derived from experience, but, as the experience from which we derive it commences with our existence, and it is of no importance to us by what means we acquire it, it is a necessary consequence that we should wholly overlook the means of its acquisition; as, for example, we judge of distance by the eye, without thinking of the means by which we have been enabled to do so, and at first can hardly believe that they are such, as on inquiry we find them to be.

* See Part II. Chapter 9, on the use of the Ganglions.

† Ib.

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Art. VI. *View of the Progress of Astronomy in Germany, for* 1818. *Extracted from Lindenau's Journal.*

i. January *and* February, 1818.

I. *Laplace on the Application of the Theory of Probabilities to Geodetical Operations.*

From the Annales de Chimie.

II. *Littrow on Observations with the Transit Instrument.*

Taking the instrument of Königsberg, as employed by Bessel, for a favourable specimen, Professor Littrow examines the mean error of a great number of observations of transits of a star, and he infers that the mean error of a single observation was about ″,12 in time, the most probable error ″,10; the most probable error of the mean of the observations on three wires ″,058; with five wires, the most probable error would have been ″,045; and with seven ″,038. He infers that it is perfectly right to carry our calculations, in general, to hundredths of seconds of time; but that we cannot be sure even of tenths of seconds of space, unless we employ as many as 200 wires; and that we may, in almost all cases, be satisfied with calculating to a single second, when space is concerned, without adverting to its fractions.

For determining the rate of a clock within half a second of space, it appears that 15 pairs of stars must be observed on two successive days, the most probable error of a single observation of this kind being ″,13 in time.

The difference of two right ascensions of stars is also ascertained by a single observation within ″,13 as the most probable error: so that to obtain the precision of ″,01 in time, we require about 170 observations. The clock, however, does not appear to have been remarkably good.

For the immediate right ascensions, or the accuracy of the setting of the clock, the most probable error of 275 observations was ″,18 in time; so that for a second of space we should require at least a comparison of 7 observations, and more than 100, to be tolerably certain within $''\frac{1}{4}$; consequently, the em-

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ployment of fractions of seconds must, in this case, also be commonly superfluous.

The author observes that in a former essay he had found the most probable error of Carlini's circle, or of the three foot multiplying circles of Milan and Ofen, equal to ″,75, which is only $\frac{1}{3}\frac{2}{8}$ of that of the determination of the right ascension by a transit: and even the more imperfect circle of Königsberg, without being turned round, affords a precision about one-third greater than that of the right ascensions.

III. *Bessel on the Influence of the Changes in the Earth's Substance upon the Latitudes of Places,*

Demonstrates that no human operations can produce a sensible alteration in the conditions of the earth's rotation.

Mr. Laplace has more lately advanced the ingenious observation, that any material diminution of the mean temperature of the earth's substance might have been detected by the diminution of the length of the day: and we shall find, on computation, that a single degree of Fahrenheit might make an alteration of nearly a second in the diurnal period of rotation, and four or five minutes in the length of the year.

IV. *Bohnenberger on the Adjustment of Astronomical Circles.*

By means of two objects at opposite points of the horizon, with some other expedients of a similar nature.

V. *Muffling's History of the Measurement of the Rhine.*

With remarks on the best modes of executing maps.

VI. *Hagen's Calculation of Observations of the Solar Eclipse of November* 1816.

Finds about 9′ 22″,46 for the difference of longitude of Blackheath and Paris, according to Mr. Groombridge's observation of this eclipse, which, however, does not agree remarkably well with others. At the end of the paper we have the formulas employed by Bohnenberger in the calculation of eclipses, and some very convenient tables of Professor Bessel, corrected and enlarged.

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VII. *Littrow on the Motion of the Earth round its Centre of Gravity.*

This interesting paper is intended as a specimen of a simplification of some of the calculations in the Mécanique céleste, which Professor Littrow has already extended to the second and fifth books of that elaborate work; and which all true lovers of mathematical science will be anxious for his continuing and making public with as little delay as possible.

VIII. *Buzengeiger on the Methods employed by the Greek Geometers in the Extraction of Roots.*

Principally from Archimedes and Theon after Commandine.

IX. *Littrow's Contributions to the Geography of Hungary.*

From observations of Bogdanich, in his last illness, not agreeing well with each other.

X. *David on Negative Refraction in the Neighbourhood of the Earth.*

The observations were made at Prague, but they merely show some irregularities in the refractions of the sun's rays, at considerable altitudes.

XI. *Extracts from Zach's Letters.*

The first relates to records of eclipses, and the errors of ephemerides; the second to the family of Bonaparte.

XII. *Extract of a Letter from Professor Littrow.*

On the accuracy of the circle used by Bessel.

XIII. *Zach on two Comets observed by Pons.*

Their places somewhat loosely determined with moderate instruments.

XIV. *Extract of a Letter from Dr. Olbers.*

Containing observations, and the elements of one of Pons's comets.

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XV. *Notice of a Meteorological Work,*

By Dr. Schoen of Würzburg.

XVI. *Notice of a Map of the Kingdom of Hanover,*

In twenty sheets, by Captain Müller.

ii. MARCH *and* APRIL.

XVII. *Posselt on finding the Time from the Anomaly in very eccentric Orbits.*

A solution resembling that which Bessel had before given of the converse of the problem, derived from the motion in a parabola, with tables: it depends on a combination of two powerful instruments, the Taylorian theorem, and the method of indeterminate coefficients.

XVIII. *Westphal's Elements of Ceres.*

The author finds, from the calculation of 6 oppositions, compared with Gauss's tables of perturbations, the following elements for Jan. 0. 1818, Gottingen time.

Mean longitude	326° . 51′ . 7″
Mean tropical daily motion	770″,7783
Logarithm of the greater semiaxis..	0.4421029
Perihelium	147° . 18′ . 22″
☊	80☌ . 45′ . 19″
Inclination of the orbit	10☌ . 37′ . 55″
Eccentricity (= sin. 4° . 28′ . 57″,9)	0.0781589

XIX. *Posselt's Table of the Place of Juno.*

Up to July 1819, from Professor Nicolai's elements.

XX. *Encke's Calculation of Occultations.*

The most remarkable circumstance in this paper is the coincidence of two observations made at Gottingen by Gauss and Harding, the difference being, in each instance, only one tenth of a second of time. The mean error of five corresponding observations at Gottingen and at Seeberg was ¼ of a second of

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time: so that we may depend on the difference of longitude, as being probably correct within less than half a second of time.

XXI. *Lindenau's further Account of Pons's Comet of* 1817.

Remarks some unexpected anomalies in its illumination.

XXII. *Wurm on Computations with small Arcs.*

Tables for readily finding the logarithms with accuracy.

XXIII. *Wurm's Continuation of Investigations respecting ancient Eclipses.*

Chiefly those mentioned by Zach. Observes that some omissions in a celebrated almanac may have been occasioned by a reliance on Pingré's catalogue in the *Art de vérifier les dates:* [nor are they the only omissions in that catalogue.]

XXIV. *Gauss on some Corrections to be applied to Borda's Repeating Circles.*

Chiefly for the purpose of making the visual line parallel to the plane of the circle. The author employs an image reflected from quicksilver, for bringing the instrument into a vertical plane.

XXV. *Zach on Trigonometrical Operations in Tuscany.*

From some very numerous series of observations, of his own and Inghirami's, the author forms the important conclusion, that an error of from 5 to 10 seconds may remain undetected in the mean of many hundred observations with the 12 inch repeating circles of Reichenbach. The paper contains a catalogue of the latitudes and longitudes of places in the neighbourhood of Florence.

XXVI. *Olbers on the Influence of the Moon upon the Weather.*

This distinguished mathematician and most respectable physician, the father of a little colony of science and refinement, in a town occupied before his time almost exclusively by the plodding pursuits of commercial speculations, undertook, some time since, in a public lecture which he delivered to a mixed audience, the

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discussion of the popular notions of the influence of the moon on the weather, and on diseases; and though his abundant candour leads him to admit the possibility of some such opinions having been founded on fact in warmer climates, he decidedly denies that any connexion between the changes of the moon and of the weather is ever observable in the north of Germany; and he asserts that, in the course of an extensive medical practice continued for a number of years, with his attention constantly directed to the lunar periods, he has never been able to discover the slightest connexion between those periods and the increase or decrease of diseases, or their symptoms.

XXVII. *Occultations of Stars for* 1819.

The particulars of each are calculated for Florence: they extend to stars of the 7th and 8th magnitudes.

XXVIII. *Encke on the Comet of* 1818.

The parabolic elements here exhibited represent all the observations within about 4' at the utmost.

XXIX. *Nicolai's new Elements of Juno.*

Mean longitude 1819, Manheim ..	117° . 45′ . 2″,84
Daily tropical motion	813″,86981
Longitude of the Perihelium	53° . 32′ . 56″,09
Angle of eccentricity	14° . 53′ . 17″,44
Ascending node.....	171° . 6′ . 50″,23
Inclination of the orbit.....	13° . 3′ . 37″,29
Logarithm of the greater semiaxis	0.4263500

A table of the places of the planet, up to May 1819, is subjoined: they differ a degree or two from Posselt's.

XXX. *Littrow's Observations of the Obliquity of the Ecliptic.*

From 15 observations at Ofen, in 1818, the mean obliquity for the 21st June, appears to be 23° . 27′ . 49″,28; the errors of the separate observations amounting to a second or two.

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XXXI. *Littrow's Determination of the Right Ascension of α Aquilæ.*

From the observations at Königsberg, and by a method suggested by Professor Bessel, makes it, after forming 35 equations of condition, and finding the minimum of the sum of the squares of the errors, $19^h\ 41'\ 45'',180$, for the beginning of 1815; that is $''$,023, or $''$,35 of space, more than Bessel's new catalogue.

XXXII. *Extract of a Letter from Professor Bessel.*

Observes that, whatever may be the true latitude of Greenwich, the reduction of Bradley's observations requires the employment of $51°\ .\ 28'\ .\ 39'',6$.

XXXIII. *Extract of a Letter from the Chevalier Bürg.*

Containing oppositions of the new planets, and of some others.

XXXIV. *Extract of a Letter from the Chevalier Gauss.*

Containing the elements of Dr. Olbers's comet.

XXXV. *Extract of a Letter from the Baron Von Zach.*

A very interesting account of the operations of Captain W. H. Smyth, of H. M. S. Aid, in the survey of the Mediterranean, with a determination of the situations of a variety of important points; and with some particulars of the travels of Hornemann, and of Captain Smyth's expedition to the petrified city in the interior of Africa. The latitudes vary a minute or two from the determinations of Gautier, published in the *Connaissance des Tems* for 1821.

iii. MAY *and* JUNE.

XXXVI. *Zach's further Remarks on the Discordance of the Italian Observations.*

The author attributes an uncertainty of $3'',5$ even to the latitude of Greenwich, at least with respect to the observations made with levels or plumb-lines. In Italy he had before detected errors of more than $20''$ in the latitudes of some observatories; finding for Padua $45°\ .\ 24'\ .\ 2''$, for Bologna

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44° . 29′ . 54″, and for Turin 4[5]° . 4′ . 0″. But nothing like an explanation of the irregularity between Florence and Pisa is attempted. The editor, however, is disposed to give the preference to the trigonometrical determination.

XXXVII. *Mossotti's new Mode of determining an Orbit.*

Principally applicable to the first estimation of the elements of a comet.

XXXVIII. *Littrow on the Arguments of Aberration and Nutation.*

A mode of adapting the tables calculated for a given year to any other year with little trouble. The author has arranged in a short table the differences of the sun's longitude and the place of the moon's node, to minutes, for the corresponding days of different years from 1750 to 1830, compared with 1817: he has also added a smaller table of the allowance to be made for the time of different meridians.

XXXIX. *Littrow on the Right Ascensions of the principal fixed Stars.*

The 36 stars of Maskelyne compared with α Aquilæ, from Bessel's observations at Königsberg.

XL. *Littrow on the Determination of Time.*

Recommends the employment of a circle in the manner of a transit instrument, where this instrument is not at hand; and employs the pole star for the latitude.

XLI. *Plana's Observations of Occultations at Turin.*

From 1812 to 1817, 25 observations.

XLII. *Extract of a Letter from Professor Bessel.*

A determination of the law of the coefficients of the series for expressing the equation of the centre and the radius vector in terms of sines and cosines of multiples of the mean anomaly, obtained from the fluents of particular expressions, when it had been

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more usual to employ Lagrange's mode of deriving them from the different orders of fluxions.

XLIII. *Chladni's Remarks on Cosmological Circumstances.*

The author collects several accounts of dark substances passing over the sun, though foreign to the solar system; and of temporary stars, one of which he suspects may have appeared periodically. But the most interesting part of the paper is the notice of some observations of Fraunhofer on the light of the stars, published in the 56th volume of *Gilbert's Annals*, but hitherto little known in this country. Fraunhofer has discovered, it seems, more than 500 dark streaks crossing the spectrum into which the solar light is expanded by a prism, and of which he gives a figure; not being, perhaps, aware that they had been before observed by Dr. Wollaston: but the novelty is, that each fixed star has a peculiar arrangement of the streaks, so that this experiment indicates a new mode of distinguishing lights apparently of precisely the same nature. Dr. Wollaston has noticed a still more marked interruption of the spectrum produced by the blue light of a candle; and Dr. Young has observed a similar appearance in light transmitted by several kinds of coloured glasses.

XLIV. *Brandes on the mean Temperature of the different Times of the Year.*

Professor Brandes has computed the mean temperatures for intervals of five days, from the Journal of the Royal Society in London, for two periods of five years each. He has remarked that in London, as well as at Stockholm, there is a temporary elevation towards the beginning, and a depression towards the middle of February: but a similar variation which he notices in March may, perhaps, be partly dependent on the hour at which the thermometer was observed.

iv. JULY *and* AUGUST.

I. *Littrow on the Right Ascension of the principal Fixed Stars.*

Deduced from all the observations in the first and second

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volume of Bessel's publication. The places finally obtained agree very nearly with a catalogue deduced from a smaller number of observations by Bessel himself, which he has lately sent over to this country. The most probable error, according to Professor Littrow's calculation, never amounts to the hundredth of a second of time; the correction of Bessel's former determination never to $\frac{1}{4}''$.

II. *An Attempt to determine the most probable Orbit of the Comet of* 1680.

A very elaborate essay, continued to the next Number. The author remarks that the whole of Flamsteed and Newton's observations may be represented without an error of more than about 20″ of space; and he has rejected those of many other persons, which exhibited errors of from 5′ to 10′. The period is supposed to be 1589,2 Julian years.

III. *Bohnenberger on a Problem in Practical Geometry.*

A convenient mode of finding, upon a plain table, a point from which three other points subtend given angles.

v. SEPTEMBER *and* OCTOBER.

IV. *Continuation of the Essay on the Comet.*

From a very laborious investigation of all the observations, and a comparison of their probable values; the corrected period is found 8814 Julian years, the greatest probable limits of its uncertainty being 6179 and 14030. The mean error of the observations is only half as great on this hypothesis, as upon Halley's, of a period of about 575 years; and as Bessel has observed, the very circumstance of the accuracy of the recurrence at three successive periods of 575 years, is of itself an improbability, since the planetary perturbations must, in general, have altered the period from time to time as much as four or five years.

V. *Sequel of Piazzi's Life.*

Piazzi was born 19th March, 1746. The principal events of

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his life are recorded in the *Monthly Correspondence* for 1810. Among the later occurrences, the first that is here mentioned is his being appointed to examine the state of the weights and measures of Sicily, and his giving the preference to a system of binary subdivision, founded on the measures already employed at Palermo, in preference to the decimal system of the French. His various astronomical discoveries and publications are as universally esteemed as they are elaborate and important; and he has still the happiness of enjoying his faculties wholly unimpaired, at the advanced age which he has attained.

VI. *Bessel's Formulas for the computation of Nutation and Aberration.*

The subject of this essay is of great importance to the cultivation of the more refined departments of astronomy, and the ingenious author has bestowed on it no common share of industry and accuracy: but his investigations appear to be somewhat unnecessarily complicated, and it will be practicable to introduce the only material parts of them into a demonstration conducted in a more geometrical and more intelligible form. [See Art. II. page 21.]

VII. *Littrow on the Eclipse of the 7th September*, 1820.

Tables showing the path of the shadow in this remarkable eclipse, and the times of its beginning and end for all the principal parts of Germany. The author has also given a very convenient formula for finding the apparent time of the beginning and end at any other place, of which the longitude E. from Paris in hours is h, and the latitude in degrees d; the beginning, in the time of the place in question, being $2^h,412 + 1,304\,d - ,03504\,d$; and the end $5^h,550 + 1,102\,h - ,03999\,b$; and the angle made, at the beginning of the eclipse, by the line joining the centres with the vertical line, being $52°,359 + 28,463\,h$. Thus, for Greenwich we have $h = -,1555$, $d = 51,478$, and the beginning $24'\frac{1}{4}$, the end $3^h.19'\frac{1}{6}$; the Nautical Almanac giving $24'\frac{1}{4}$, and $3^h.16'\frac{1}{4}$, respectively. For Paris, $h = 0$, $d = 48,837$, and the beginning is at $42'$, the end $3^h.35'\frac{8}{10}$; while the *Connaissance*

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des Tems has 47′ and 3ʰ.35′: these differences rather exceeding the limits of inaccuracy assigned by the author to his formula.

VIII. *Geocentric Places of Pallas, by Dirksen.*

Up to June, 1820. The next opposition will 1820, Jan. 6, 20ʰ . 16′ . 41″, mean time of Gottingen; longitude 106° . 0′.16″,2, geocentric latitude 54° . 28′ . 33″,2 S.

IX. *Extracts of Letters from the Chevalier Bürg.*

Observations of the oppositions of the Georgian planet, and of Jupiter; a calculation of the eclipse of 1820, for Vienna and Gratz, agreeing within two or three minutes only with Littrow's table. The second letter is dated 5th Feb. 1819, and relates to some comets, and to an opposition of Vesta, differing from Daussy's tables only 23″ in heliocentric longitude, and 18″ in latitude; there are also some oppositions of the other planets.

X. *Extract of a Letter from Professor Schumacher.*

Relating to Vesta, and to some geographical observations.

S. B. L.

ART. VII. *On the Mammoth, or Fossil Elephant, found in the Ice, at the Mouth of the River Lena, in Siberia. From the Fifth Volume of the Memoirs of the Imperial Academy of Sciences of St. Petersburg.*

[THE following pages are translated and abridged from a paper by Dr. Tilesius in the Memoirs of the Petersburg Academy, and the figure of the skeleton is faithfully copied, but of a reduced size, from the large plate which accompanies it.

The term "Mammoth, or Fossil Elephant" has been made use of with a view to correct a common mistake in the application of the word *Mammoth*, which is in England frequently given to the Mastodon of Cuvier, the animal of which the remains are chiefly found on the banks of the Ohio and in other parts of America. The Siberians have long applied the name of "Mammoth" to the elephant whose bones are

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very abundant in that country, and in many other parts of the world, and it is so used by writers on the Continent. These remains, wherever found, belong to a species of elephant different from the two now living on the globe, and which is called by Cuvier "the Fossil Elephant:" but the propriety of applying the term *fossil* to the subject of the following memoir may perhaps be doubted; for although it is of the same species, it was not found beneath the surface of the earth, but in ice, and retained its flesh and all its softer parts in a state of perfect freshness.

A very complete dissertation on the fossil and living elephants, by M. Cuvier, is inserted in the eighth volume of the *Annales du Muséum d'Histoire Naturelle*, and has been re-published in his *Recherches sur les Ossemens fossiles de Quadrupèdes.*]

ACCORDING to several writers, the term Mammoth is of Tartar origin, and is derived from *mama*, which signifies the earth*, and the natives of Siberia give the name of "bones of the Mammoth" to the remains of elephants which are found in great abundance in that country, believing that the Mammoth is an animal which lives underground at the present time.

The Mammoth, or elephant's bones and tusks, are found throughout Russia, and more particularly in Eastern Siberia and the Arctic marshes. The tusks are found in great quantities, and are collected for the sake of profit, being sold to the turners in the place of the living ivory of Africa and the warmer parts of Asia, to which it is not at all inferior.

Almost the whole of the ivory-turners' work made in Russia is from the Siberian fossil ivory, and sometimes the tusks, having hitherto always been found in abundance, are exported rom thence, being less in price than the recent. Although, for a long series of years, very many thousands have been annually obtained, yet they are still collected every year in great numbers on the banks of the larger rivers of the Russian empire, and more particularly those of further Siberia. They abound most of all in the Laichovian Isles and on the shores of the Frozen Sea.

* According to others, it is derived from *behemoth*, mentioned inthe book of Job; or *mehemoth*, an epithet which the Arabs commonly add to the word Elephant, to designate one which is very large. See *Cuvier, Ann. du Mus.* vol. 8, p. 45.

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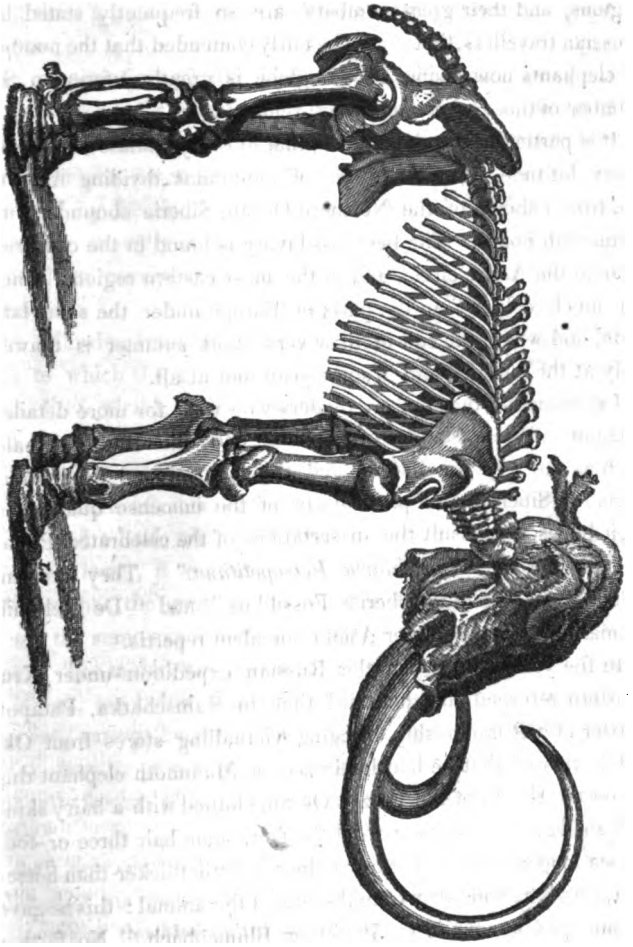

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In digging wells or foundations for buildings there are every where discovered the entire skeletons of elephants, which are very well preserved in the frozen soil of that country. The instances of these bones being found in the above-mentioned regions, and their great numbers, are so frequently stated by Russian travellers, that it may be fairly contended that the number of elephants now living on the globe is greatly inferior to the number of those whose bones are remaining in Siberia.

It is particularly to be noticed, that in every climate and under every latitude, from the range of mountains dividing Asia, to the frozen shores of the Northern Ocean, Siberia abounds with Mammoth bones. The best fossil ivory is found in the countries near to the Arctic circle, and in the most eastern regions, which are much colder than the parts of Europe under the same latitude, and where the soil in their very short summer is thawed only at the surface, and in some years not at all.

I recommend those of my readers who wish for more detailed accounts of the skeletons of elephants and other large animals, such as the gigantic buffalo and rhinoceros found in different parts of Siberia, and particularly of the immense quantity of their bones, to consult the dissertations of the celebrated Pallas in the "*Nova Commentaria Petropolitana.*" They are entitled "De Ossibus Siberiæ Fossilibus," and "De Reliquiis animalium exoticorum per Asiam borealem repertis.

In the year 1805, when the Russian expedition under Krusenstern returned for the third time to Kamschatka, Patapof, master of a Russian ship bringing victualling stores from Okhotsk, related that he had lately seen a Mammoth elephant dug up on the shores of the Frozen Ocean, clothed with a hairy skin; and shewed in confirmation of the fact, some hair three or four inches long of a reddish black colour, a little thicker than horse-hair, which he had taken from the skin of the animal: this he gave to me, and I sent it to Professor Blumenbach. No further knowledge has been obtained on this subject, and unfortunately Patapof was not employed by any of our Societies to return to Siberia. Thus has this curious fact been consigned to oblivion; nor should we now possess any information respecting the car-

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case of the Mammoth, which forms more particularly the subject of this memoir, if the rumour of its discovery had not reached Mr. Adams, a man of great ardour in pursuit of science, who undertook the labour of a journey to these frozen regions, and of preparing these gigantic remains and transporting them to a great distance.

The preservation of the flesh of the mammoth through a long series of ages, is not to be wondered at, when we recollect the constant cold and frost of the climate in which it was found. It is a common practice to preserve meat and berries through the winter by freezing them, and to send fish, and all other provisions, annually at that period, from the most remote of the northern provinces, to St. Petersburg and other parts of the empire.

The following interesting account is given by Gmelin, of the depth to which the ground is thawed in summer. (*Floræ Sibericæ*, Pref. xlvii.) "At Jakutsk, on the 8th of June, I ordered the ground to be dug in an elevated field, as deep as it was thawed. The mould extended to the depth of eleven inches; underneath it was sand, which was soft to the depth of two feet and a half, when it became harder; and after digging half a foot lower, it was very hard, and scarcely yielded to the spade, so that the ground was thawed scarcely four feet. I directed the same experiment to be tried at a lower spot not far distant. The mould was ten inches deep, the soft sand two feet four inches, but below this every thing was frozen quite hard. Moreover, various berries, which the Jakutski consider as delicacies, may be preserved in caves in the same state, that is, continually frozen, although the caves are scarcely the depth of six feet."

I shall now proceed to the account which Mr. Adams has published of his journey to the Icy Sea, and to the place where the carcase of the Mammoth, whose skeleton is now to be seen in our museum, was found lying on the sand and ice. It was first published in the *Journal du Nord*, printed at St. Petersburg, in 1807, under the title of *Relation abrégé d'un Voyage à la Mer Glaciale, et Découverte des restes d'un Mammouth*," and

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afterwards in some German ephemerides; but as they are now scarce, I shall cite his own words.

'I should reproach myself if I longer delayed the publication of a zoological discovery, which is highly interesting in its detail, since it makes us acquainted with a species of animal, whose existence was a subject of dispute among our best informed naturalists.

'I was told at Jakutsk by the merchant Popoff, chief of the body of merchants of that town, that there had been discovered on the shores of the Frozen Ocean, near the mouth of the river Lena, an animal of extraordinary magnitude. The flesh, the skin, and the hair, were in a state of preservation, and it was supposed that the fossil production known under the name of Mammoth's horns, must have belonged to an animal of this species. Mr. Popoff, had at the same time the kindness to present me with a drawing and description of this animal, and I thought it right to send them both to the President of the Academy of Petersburg*. The news of this interesting discovery determined me to hasten the journey which I had in contemplation for the purpose of visiting the shores of the Lena as far as the Frozen Ocean; wishing to preserve these precious remains, which might otherwise be lost. My stay at Jakutsk consequently did not last many days; I set off on the 7th of June, 1806, furnished with some necessary letters, of which part were for the agents of government and the merchants, whose assistance I thought would be useful in my researches. On the 16th of June I arrived at the little town of Schigansk, and towards the end of this same month I was at Kuma-Surka; from thence I made a particular excursion, of which the Mammoth was the object, and I will now relate what my journal contains on that subject†.

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* Tilesius says these are both preserved in the academy, but describes the drawing as very bad, representing a pig rather than an elephant, with red hair on the back. He says that the description was quite worthy of the drawing.

† Some parts of this account, not immediately relating to the object in view, are here omitted.

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'The contrary winds which had prevailed during the whole summer, delayed my departure from Kuma: this place was then inhabited by forty or fifty Tungusian families, who were generally employed in fishing, *&c.*

'The wind having at length changed, I determined to pursue my journey, and passed my rein-deer across the river. The next day at sun-rise I set off, accompanied by the Tungusian chief Ossip Schumachof, the merchant of Kuma-Surka, Bellkoff, my hunter, three Kossaks, and ten Tungusians. The Tungusian chief was the person who had first discovered the Mammoth, and who was proprietor of the territory through which our route lay. The merchant of Kuma-Surka had passed almost all his life on the shores of the Frozen Sea; his zeal and the advice he gave me have the strongest claim to my gratitude, and I even owe to him the preservation of my life in a moment of danger.

'We passed in our way over high steep mountains, valleys which followed the course of small brooks, and dry and wild plains, where not a shrub was to be seen. After two days' travelling we arrived at the shores of the Frozen Ocean. The Tungusians called it Angardam, or Terra Firma. To reach the Mammoth we were obliged to traverse a peninsula, called Byschofskoy-Mys or Tamut. This peninsula, which stretches into a spacious gulf, is on the right of the mouth of the Lena, and extends, as I was informed, from south-east to north-west, for the length of 80 wersts, (about 53 miles.) The name is probably derived from two points like horns, which are at the northern end of the promontory. The point on the left, which the Russians more especially call Byschofskoy-Mys, on account of its greater extent, forms three large gulfs, where are some Jakutsk settlements: the opposite point, called Manstai, on account of the great quantity of floating wood found on its shore, is of half the size; the bank is lower, and this canton is completely inhabited. The distance from one point to the other is reckoned at 45 wersts (30 miles.) Hills form the more elevated part of the peninsula of Tamut. The rest is occupied by lakes, and all the low lands are marshy, *&c.*

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'The peninsula, of which we have just spoken, is so narrow in some places that the sea is seen on both sides. The rein-deer migrate every year regularly, abandoning these places to proceed by the frozen sea towards Borchaya and Nytjansk, and for this purpose they assemble in large troops towards the autumn*. To follow the chase of these animals with greater success, the Tungusians have divided all the country of this peninsula into departments separated by paling. They alarm the rein-deer by loud cries, and by dogs which pursue them. The rein-deer frightened by this noise run into the enclosures of the palings, where they are easily taken; all those which try to escape on the ice are shot by the hunters.

'The third day of our journey we pitched our tents at some hundred paces distant from the Mammoth, on a hill called Kembisaga-Shaeta.'

Schumachof related to me nearly in these terms the history of the discovery of the Mammoth.

'The Tungusians, who are a wandering people, remain but a little time in the same place. Those who live in the forests often take ten years or more to travel over the vast regions between the mountains; during this time they do not once return to their habitations. Each family lives isolated, and knows no other society. If, during the course of several years, two friends meet by chance, they then communicate to each other their adventures, their different successes in hunting, and the number of skins they have obtained. After having passed some days together, and consumed the few provisions they had, they separate cheerfully, carrying each other's compliments to their acquaintance, and trusting to Providence for another meeting. The Tungusians inhabiting the coast differ from the former in having more regular and fixed habitations, and in collecting together at certain seasons for fishing and hunting. During winter they inhabit cottages built side by side, so that they form villages.

'It is to one of these annual trips that we owe the discovery of the Mammoth. Towards the end of the month of August,

* *Sauer Beschreibung der Billingschen Reise*, p. 130.

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when the fishing season in the Lena is over, Schumachof generally goes with his brothers to the peninsula of Tamut, where they employ themselves in hunting, and where the fresh fish of the sea offer them a wholesome and agreeable food. In 1799 he had constructed for his wife some cabins on the banks of the lake Oncoul, and had embarked to seek along the coasts for Mammoth horns. One day he perceived among the blocks of ice a shapeless mass, not at all resembling the large pieces of floating wood which are commonly found there. To observe it nearer, he landed, climbed up a rock, and examined this new object on all sides, but without being able to discover what it was.

'The following year (1800), he found the carcase of a walrus, *(Trichecus Rosmarus.)* He perceived, at the same time, that the mass he had before seen was more disengaged from the blocks of ice, and had two projecting parts, but was still unable to make out its nature. Towards the end of the following summer (1801) the entire side of the animal and one of his tusks, were quite free from the ice. On his return to the borders of the lake Oncoul, he communicated this extraordinary discovery to his wife and some of his friends; but the way in which they considered the matter filled him with grief. The old men related on the occasion their having heard their fathers say, that a similar monster had been formerly seen in the same peninsula, and that all the family of the person who discovered it had died soon afterwards. The Mammoth was, in consequence, unanimously considered as an augury of future calamity, and the Tungusian chief was so much alarmed that he fell seriously ill; but becoming convalescent, his first idea was the profit which he might obtain by selling the tusks of the animal, which were of extraordinary size and beauty. He ordered that the place where the Mammoth was found should be carefully concealed, and that strangers should, under different pretexts, be diverted from it, at the same time charging trust-worthy people to watch that the treasure was not carried off.

'But the summer of 1802, which was less warm and more windy than common, caused the Mammoth to remain buried in

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the ice, which had scarcely melted at all. At length, towards the end of the fifth year, (1803), the ardent wishes of Schumachof were happily accomplished; for the part of the ice between the earth and the Mammoth having melted more rapidly than the rest, the plane of its support became inclined, and this enormous mass fell by its own weight on a bank of sand. Of this, two Tungusians, who accompanied me, were witnesses.

'In the month of March, 1804, Schumachof came to his Mammoth, and having cut off his horns (the tusks) he exchanged them with the merchant Bultunof for goods of the value of 50 rubles. At this time a drawing was made of the animal, but very incorrect*, for it gave him pointed ears, very small eyes, horses' hoofs, and bristles all along the back, so that it represented something between a pig and an elephant.

'Two years afterwards, or the seventh after the discovery of the Mammoth, I fortunately traversed these distant and desert regions, and I congratulate myself in being able to prove a fact which appears so improbable. I found the Mammoth still in the same place, but altogether mutilated. The prejudices being dissipated, because the Tungusian chief had recovered his health, there was no obstacle to prevent approach to the carcase of the Mammoth; the proprietor was content with his profit from the tusks, and the Jakutski of the neighbourhood had cut off the flesh, with which they fed their dogs during the scarcity. Wild beasts, such as white bears, wolves, wolverenes, and foxes, also fed upon it, and the traces of their footsteps were seen around. The skeleton, almost entirely cleared of its flesh, remained whole, with the exception of one fore-leg†. The spine from the head to the os coccygis‡, one scapula; the basin, and the other three extremities, were still held together by the ligaments, and by parts of the skin. The head was covered with a dry skin; one of the ears, well preserved§, was furnished with a tuft of hairs.

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* This is the drawing before mentioned, page 100, note.

† This has been restored in plaster of Paris from the other side.

‡ This is an error, as of 28 or 30 caudal vertebræ, only 8 are remaining.

§ The ears are not well preserved, but may, perhaps, have suffered in so long a carriage.

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'All these parts have necessarily been injured in transporting them a distance of 11,000 wersts (7,330 miles.) Yet the eyes have been preserved, and the pupil of the left eye can still be distinguished*. The point of the lower lip had been gnawed, and the upper one having been destroyed, the teeth could be perceived. The brain was still in the cranium, but appeared dried up.

'The parts least injured are one fore foot and one hind foot; they are covered with skin, and have still the sole attached. According to the assertion of the Tungusian chief, the animal was so fat and well fed that its belly hung down below the joints of the knees. This Mammoth was a male, with a long mane on the neck, but without tail or proboscis†. The skin, of which I possess three-fourths, is of a dark grey colour, covered with a reddish wool and black hairs. The dampness of the spot where the animal had lain so long, had in some degree destroyed the hair. The entire carcase, of which I collected the bones on the spot, is four archines (9 ft. 4 in.) high, and seven archines (16 ft. 4 in.) long from the point of the nose to the end of the tail, without including the tusks, which are a toise and a half‡ in length; the two together weighed 360 lbs. avoirdupois; the head alone, without the tusks, weighs 11 poods and a half (414 lbs. avoirdupois.)

'The principal object of my care was to separate the bones, to arrange them, and put them up safely, which was done with particular attention. I had the satisfaction to find the other scapula, which had remained not far off. I next detached the skin of the side on which the animal had lain, which was well preserved. This skin was of such extraordinary weight that ten persons found great difficulty in transporting it to the shore. After this I dug the ground in different places to ascertain

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* A dried substance is visible, but it is not certain whether it is the pupil of the eye.

† The places of the insertion of the muscles of the proboscis are visible on the skull, it was probably devoured as well as the end of the tail.

‡ 9 ft. 6 in., measuring along the curve. The distance from the base of the root of the tusk to the point is 3 ft. 7 in.

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whether any of its bones were buried, but principally to collect all the hairs * which the white bears had trod into the ground while devouring the flesh. Although this was difficult from the want of proper instruments, I succeeded in collecting more than a poud (36 pounds) of hair. In a few days the work was completed, and I found myself in possession of a treasure which amply recompensed me for the fatigues and dangers of the journey, and the considerable expenses of the enterprise.

'The place where I found the Mammoth is about 60 paces distant from the shore, and nearly 100 paces from the escarpment of the ice from which it had fallen. This escarpment occupies exactly the middle between the two points of the peninsula, and is three wersts long, (two miles), and in the place where the Mammoth was found, this *rock* has a perpendicular elevation of 30 or 40 toises. Its substance is a clear pure ice; it inclines towards the sea; its top is covered with a layer of moss and friable earth, half an archine (14 inches) in thickness. During the heat of the month of July a part of this crust is melted, but the rest remains frozen. Curiosity induced me to ascend two other hills at some distance from the sea; they were of the same substance and less covered with moss. In various places were seen enormous pieces of wood of all the kinds produced in Siberia; and also Mammoths' horns in great numbers appeared between the hollows of the rocks; they all were of astonishing freshness.

'How all these things could become collected there, is a question as curious as it is difficult to resolve. The inhabitants of the coast call this kind of wood *adamschina*, and distinguish it from the floating pieces of wood which are brought down by the large rivers to the ocean, and collect in masses on the shores of the frozen sea. The latter are called *noachina*. I have seen, when the ice melts, large lumps of earth detached from the hills, mix with the water, and form thick muddy torrents, which roll slowly towards the sea. This earth forms wedges which fill up the spaces between the blocks of ice.

* On the arrival of the skin at Petersburg it was totally devoid of hair.

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'The escarpment of ice was 35 to 40 toises high; and, according to the report of the Tungusians, the animal was, when they first saw it, seven toises below the surface of the ice, &c.

'On arriving with the Mammoth at Borchaya, our first care was to separate the remaining flesh and ligaments from the bones, which were then packed up. When I arrived at Jakutsk, I had the good fortune to re-purchase the tusks, and from thence expedited the whole to St. Petersburg.'

The skeleton is now put up in the museum of the academy, and the skin still remains attached to the head and the feet.

The Mammoth is described by M. Cuvier as a different species from either of the two elephants living at the present day, the African or the Indian. It is distinguished from them by the teeth, and by the size of the tusks, which are from ten to fifteen feet long, much curved, and have a spiral turn outwards. The alveoli of the tusks are also larger, and are produced farther. The neck is shorter, the spinal processes larger, all the bones of the skeleton are stronger, and the scabrous surfaces for the insertion of the muscles more prominent than in the other species. The skin being covered with thick hair, induces M. Cuvier to consider that it was the inhabitant of a cold region. The form of the head is also different from that of the living species, as well as the arrangement of the lines of the enamel of the teeth: but for these and other particulars, see the Memoirs of M. Cuvier in the *Annales du Muséum d'Histoire Naturelle.*

The Mammoth more nearly resembles the Indian than the African species of elephant.

'A part of the skin and some of the hair of this animal was sent by Mr. Adams to Sir Joseph Banks, who presented them to the Museum of the Royal College of Surgeons. The hair is entirely separated from the skin, excepting in one very small part, where it still remains firmly attached. It consists of two sorts, common hair and bristles, and of each there are several

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varieties, differing in length and thickness. That remaining fixed on the skin is of the colour of the camel, an inch and an half long, very thick set, and curled in locks. It is interspersed with a few bristles, about three inches long, of a dark reddish colour.

Among the separate parcels of hair are some rather redder than the short hair just mentioned, about four inches long, and some bristles nearly black, much thicker than horse-hair, and from 12 to 18 inches long.

The skin when first brought to the museum was offensive. It is now quite dry and hard, and where most compact is half an inch thick. Its colour is the dull black of the living elephants.

Art. VIII. *On the Figure of the Earth. By* M. de Laplace.

The multiplied experiments made with the pendulum have shewn that the increase of gravity follows a very regular progression, and that it is very nearly as the square of the sine of the latitude. This force being the result of the attractions of all the terrestrial molecules, observations of it, compared with the theory of the attraction of spheroids, offer the only means which can enable us to penetrate into the internal constitution of the earth. The result is, that this planet is formed of strata, of which the density increases from the surface to the centre, and which are arranged regularly round that point. I have published, at the end of the *Connaissances des Tems* for 1821, the following Theorem, which I have demonstrated in the second volume of the *Nouveaux Mémoires de l'Académie des Sciences.*

" If the length of the seconds pendulum at the equator be taken as unity, and if to the length of this pendulum, observed at any point on the surface of the terrestrial spheroid, be added, half the height of this point above the level of the ocean, divided by half the polar axis, a height which is given by barometrical observation, the increase of this length, thus corrected, will be, on the hypothesis of a constant density below a small depth,

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equal to the product of the square of the sine of the latitude by five fourths of the ratio of the centrifugal force to the gravity at the equator, or by 43 ten-thousandths."

This theorem is generally true, whatever may be the density of the sea, and the manner in which it covers the earth.

Experiments with the pendulum made in the two hemispheres, agree in giving to the square of the sine of the latitude, a coefficient somewhat larger, and nearly equal to 54 ten-thousandths. It is therefore well proved by these experiments that the earth is not homogeneous in the interior, and that the density of the strata increases from the circumference to the centre.

But the earth, though heterogeneous in a mathematical sense, may still be chemically homogeneous, if the increase of density of its strata is caused only by the additional pressure they suffer as they approach towards the centre. It is easy to conceive that the immense weight of the superior strata may considerably increase their density, though they may not be fluid; for it is known that solid bodies are compressed by their own weight. The law of the densities which result from these compressions being unknown, we cannot tell how far the density of the terrestrial strata may be thus increased. The pressure and the heat which we can produce are very small, compared to those which exist at the surface, and in the interior of the sun and stars. It is even impossible for us to have an idea of the effect of these forces, united in those immense bodies. Every thing tends to make us believe that they have existed at one time in a high degree on the earth, and that the phenomena which they have occasioned, modified by their successive diminution, form the present state of the surface of our globe; a state which is nothing more than the element of a curve, of which time is the abscissa, and of which the ordinates will represent the changes that this surface has suffered without ceasing. We are far from knowing the nature of this curve, and we cannot therefore ascend with certainty to the origin of what we observe on the earth; and if, to satisfy the imagination, always troubled by ignorance of the cause of the phenomena which interest us, a few conjectures are ventured, it is wise not to offer them except with extreme caution

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The density of a gas is proportional to its compression, when the temperature remains the same. This law which is found true within those limits of density, where we have been able to prove it, evidently cannot apply to liquids and solids, of which the density is very great, compared to that of gas, when the pressure is very small, or even nothing. It is natural to suppose that these bodies resist compression the more they are compressed; so that the ratio of the differential of the pressure to that of the density, instead of being constant, as with gases, increases with the density. The most simple function which can represent the ratio, is the first power of the density, multiplied by a constant quantity. It is this which I have adopted, because it unites to the advantage of representing in the simplest manner what we know of the compression of liquids and solids, a facility of calculation in researches on the figure of the earth. Until now, mathematicians have not included in this research the effect resulting from the compression of the strata. Dr. Young has called their attention to this object, by the ingenious remark, which may be thus stated, the increase of density of the strata of the terrestrial spheroid. I have supposed that some interest may be excited by the following analysis, from which it appears that it is possible to explain all the known phenomena depending on the law of the density of these strata. These phenomena are the variation of the degrees of the meridian, and of gravity, the precession of the equinoxes, the nutation of the terrestrial axis, the inequalities which the flattening of the earth produces in the motion of the moon, and lastly, the ratio of the mean density of the earth to that of water, which Cavendish has fixed by an admirable experiment at five and a half. In proceeding from the law already announced of the compression of liquids and solids, I find that, if the earth be supposed to be formed of a substance chemically homogeneous, of which the density is $2\frac{1}{4}$ that of common water, and which compressed by a vertical column of its own substance, equal to the millionth part of half the polar axis, will augment in density 5.5345 millionths of its first density, it will account for all the phenomena. The existence of such a body is very admissible, and there are apparently such on the surface of the earth.

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If the earth were entirely formed of water, and if it be supposed in conformity with the experiments of Canton, that the density of water, at the temperature of ten degrees (50°. Fahr.) and compressed by a column of water 10 metres (32.81925 ft.) in height increases by 44 millionths, the flattening of the earth would be $\frac{1}{100}$; the coefficient of the square of the sine of the latitude in the expression of the length of the second's pendulum would be 59 ten-thousandths, and the mean density of the earth would be nine times that of water. These results differ from observations by more than the errors to which they are liable.

I have supposed the temperature uniform throughout the whole extent of the terrestrial spheroid; but it is very possible that the heat is greater towards the centre, and that would be the case if the earth, originally highly heated, were continually cooling. The ignorance in which we are with respect to the internal constitution of this planet, prevents us from calculating the law by which the heat decreases, and the resulting diminution in the mean temperature of climates; but we can prove that this diminution is insensible for the last 2,000 years.

Suppose a space of a constant temperature, containing a sphere having a rotatory motion; and, suppose that after a long time the temperature of the space diminishes one degree; the sphere will finally take this new temperature; its mass will not be at all altered, but its dimensions will diminish by a quantity which I will suppose to be a hundred thousandth, a diminution which is nearly that of glass. In consequence of the principle of areas, the sum of the areas which each molecule of the sphere will describe round its axis of rotation will be the same in a given time, as before. It is easy to conclude from this, that the angular velocity of rotation will be augmented by a fifty thousandth. So that, supposing the time of a rotation to be one day, or a hundred thousand decimal seconds, it will be diminished two seconds by the diminution of a degree in the temperature of the space. If we extend this consequence to the earth, and also consider that the duration of the day has not varied since the time of Hipparchus, by the hundredth of a second, as I have shewn by the comparison of observations with the

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theory of the secular equation of the moon, we shall conclude, that since that time, the variation of the internal heat of the earth is insensible. It is true that the dilatation, the specific heat, the degree of permeability by heat, and the density of the various strata of the earth being unknown, may cause a sensible difference between the results relative to the earth, and those of the sphere we have supposed; according to which the diminution of the hundredth of a second, in the length of the day, would correspond to a diminution of two hundredths of a degree of temperature. But this difference could never extend from two hundredths of a degree, to the tenth; the loss of terrestrial heat corresponding to the diminution of a hundredth of a second in the length of the day. We may observe, even that the diminution of the hundredth of a degree, near the surface, supposes a much greater one in the internal strata; for it is known that ultimately the temperature of all the strata diminishes in the same geometric progression, so that the diminution of a degree near the surface, corresponds to a much greater diminution in the strata, nearer to the centre. The dimensions of the earth, therefore, and its *inertial momentum* would diminish more than in the case of the sphere we have supposed. Hence it follows, that if, in the course of time, changes are observed in the mean height of the thermometer placed at the bottom of the observatory caves, it must be attributed not to a variation in the mean temperature of the earth, but to change in the climate of Paris, of which the temperature may vary, with many accidental causes. It is remarkable that the discovery of the true cause of the secular equation of the moon, should at the same time make known to us the invariability of the length of the day, and of the mean temperature of the earth since the time of the most ancient observations.

This last phenomenon induces us to suppose that the earth has arrived at that permanent temperature, which accords with its position in space, and its relation to the sun. It is found by analysis, that whatever the specific heat, the permeability by heat, and the density of the strata of the terrestial spheroid, the increase of the heat, at a depth very small, compared to the

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radius of that spheroid, is equal to the product of that depth, by the elevation of the temperature of the surface of the earth, above the state of which I have just spoken, and by a factor independent of the dimensions of the earth, and which depends only on the qualities of its first stratum relative to heat. From what we know of these qualities we find that if this elevation was many degrees, the increase of heat would be very sensible at depths to which we have penetrated and where nevertheless it has not been observed.

Note by the Editor of the Annales de Chimie, &c.

We have thought that our readers would not be displeased to meet here with some details of the method by which M. de Laplace, has established the invariability of the duration of the day.

A mean solar day, is equal to the time occupied by one revolution of the earth on its own axis, increased by the mean apparent motion of the sun, in the same interval. Theory has proved that the mean apparent motion of the sun, like that of all the planets, is constant; the duration of a solar day, therefore can only vary by a change in the velocity of the rotation of the earth.

The time in which the moon returns to the same position, relative to the sun, its conjunction for instance, is called a lunar month. This interval is evidently independent of the velocity of the earth's rotation. Our globe might even cease to turn on its centre, without the moon's advancement in its orbit suffering any alteration. From hence results a very simple method of discovering if the duration of the solar day has changed.

Suppose that at present, the duration of a lunar month be ascertained by direct observation; that is, how many days, and fractions of day, the moon occupies in returning to its conjunction with the sun. It is evident that on repeating this observation at another time, a different result will be found, if the length of the day has changed, if at the same time, the velocity of the moon has not changed. The month will appear longer, if the length of the day has diminished; and on the contrary, shorter,

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if the day has increased. The constancy of the lunar month will indicate the invariability of the day.

All observations combine to prove that from the time of the Chaldeans, to our own days, the duration of the lunar month has been gradually diminishing. It follows, therefore, from what has been stated, either that the velocity of the moon has increased, or that the solar day has lengthened. But M. de Laplace has discovered by theory, that there is in the motion of the moon, an inequality known by the name of *secular equation*, which depends on the variation of the excentricity of the earth's orbit, and of which the value in each century may be deduced from the change of this excentricity. By the assistance of this equation, the increase of velocity above noticed is perfectly accounted for. There is, therefore, no reason to suppose that the duration of the day is not sensibly constant.

Let us admit for a moment, with M. de Laplace, that this duration, surpasses at present that of the time of Hipparchus, by the hundredth of a decimal second. The duration of a century now, or of 36,525 solar days, would be longer than the duration of a century 2,000 years ago, (Hipparchus lived about 120 years before our era), by 365."25. In this interval of time, the moon describes an arc of 534".6; this quantity, therefore, expresses the difference between two arcs traversed by the moon in a century now, and in one of the time of Hipparchus; but as these arcs, determined by observation and corrected by the secular equation, do not differ by a quantity so large, we may conclude that in this long interval the duration of the day has not varied by the hundredth of a second.

Annales de Chimie, xi. p. 31.

Art. IX. *On the Preparation of Oxygenated Water.* By M. Thenard.

The preparation of oxygenated water requires certain precautions, without which success will only be partial. That none may be omitted, I shall describe the process in the most minute manner.

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1. Nitrate of barytes should first be obtained perfectly pure, and, above all, free from iron and manganese. The most certain mean of procuring it is to dissolve the nitrate in water, to add to the solution a small excess of barytes water, to filter and crystallize.

2. The pure nitrate is to be decomposed by heat. This ought not to be done in a common earthen-ware retort, because it contains too much of the oxides of iron and manganese, but in a perfectly white porcelain retort. Four or five pounds of nitrate of barytes may be decomposed at once, and the process will require about three hours. The barytes thus obtained, will contain a considerable quantity of silex and alumine, but it will have only very minute traces of manganese and iron, a circumstance of essential importance.

3. The barytes, divided by a knife into pieces as large as the end of the thumb, should then be placed in a luted tube of glass. This tube should be long, and large enough to contain from one kilogramme to 1½ kilogrammes, (from 2lbs. 4oz. to 3lbs. 6oz. nearly). It is to be surrounded with fire, and heated to dull redness, and then a current of dry oxygen gas is to be passed through it. However rapid the current, the gas is completely absorbed; so that when it passes by the small tube which ought to terminate the larger one, it may be concluded that the deut-oxide of barium is finished. It is, however, well to continue the current for seven or eight minutes more. Then the tube being nearly cold, the deut-oxide, which is of a light gray colour, is taken out, and preserved in stoppered bottles.

4. A certain quantity of water, for example, two decilitres, (4¼ pints) is then taken; to which is added as much pure and fuming hydrochloric acid as will dissolve 15 grammes, (232 grains) of barytes. The acid solution is put into a glass with a foot, and ice placed round it, which must be renewed as it melts. Then 12 grammes, (185 grains,) of the deut-oxide are to be very slightly moistened, and rubbed, by portions, in a mortar of agate or glass. As these portions are reduced into a fine paste, they are to be removed by a box-wood knife, and placed in the fluid; they will soon dissolve without effervescence, especially if

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slightly agitated. When the solution is made, pure and concentrated sulphuric acid is added, drop by drop, the fluid being stirred at the time with a glass rod, until there is a slight excess of it, which is easily known by the property possessed by the sulphate of barytes formed at the moment, of readily depositing in flocculi; then, as at first, a fresh quantity of deut-oxide is dissolved in the fluid, which is again precipitated by sulphuric acid. The deut-oxide is always easy to distinguish from the sulphate. It is important to add enough sulphuric acid to precipitate all the barytes, but not too much. If enough is not added, the fluid filters with difficulty, and slowly; if too much is added, the filtration also goes on badly. On arriving at the exact point mentioned, the filtration takes place with the utmost facility. When the filtration is completed, a small quantity of common water is to be passed through the filter, and added to the first fluid; in this way the latter does not lose in volume: then, that nothing may be lost, it is necessary to spread the filter on a glass plate, to separate the substance from it, diffuse it through a small quantity of fresh water, and filter it. The water, thus obtained, is but slightly charged, but it is useful to wash the future filters.

This operation being finished, another is made exactly similar to it, *i. e.*, deut-oxide of barium is to be dissolved in the fluid; the barytes is to be precipitated by sulphuric acid, and so on; and the fluid is not to be filtered until after two solutions, and two precipitations. It is on this new filter that the water obtained by washing the precipitate in the preceding operation is to be poured; after which fresh weak water is procured by washing the matter on the last filter.

The second operation is followed by a third, that by a fourth, and thus, until the fluid is sufficiently charged with oxygen. By using the quantity of hydro-chloric acid mentioned, from 90 to 100 grammes (29 to 32ozs.) of deut-oxide of barium may be operated on, and a fluid will be obtained charged with 25 or 30 times its volume of oxygen. If it is required to be further oxygenized, more hydro-chloric acid must be added.

I have many times succeeded by this means in charging the

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fluid with 125 times its volume of oxygen, but I added acid enough to dissolve 30 grammes (463 grains) of the deut-oxide, being careful also to preserve the acidity such, that at the end of the operation I could dissolve about 20 grammes (309 grains) of the deut-oxide, without the aid of sulphuric acid; but I have ascertained that, when the fluid contains nearly 50 volumes of oxygen, it allows so much gas to escape from one day to the next, that there is no advantage in continuing to oxygenate it by the deut-oxide.

5. When the fluid is oxyginated up to the required point, it is to be saturated with deut-oxide, retaining it at the same time in ice. Abundant flocculi of silex and alumine soon separate from it, which are generally coloured yellowish-brown, by a little of the oxides of iron and manganese. The whole should then be thrown quickly on a cloth, enclosed in it, and strongly compressed. This operation cannot be done well except by two persons, and should be performed rapidly; for though there is but a very minute quantity of oxide of manganese, it is sufficient to produce a considerable disengagement of oxygen.

6. As the fluid which has passed the cloth may still retain a small quantity of silex, iron, and manganese: and as it is necessary to separate all these substances, it is again to be surrounded by ice, and barytes water added to it, drop by drop, the whole being stirred. If, when the barytes is in such excess as to be slightly sensible to coloured paper, there is no precipitate, it proves that all the oxide of iron and manganese are separated; if they have not been completely separated in the preceding operation, they will by this.

Immediately on the separation of them, the fluid must be placed in two or three filters; for the oxide of manganese disengages so much gas, that it cannot be removed too quickly. Sometimes double filters are required, because the gas separating the paper, tears those that are single. Sometimes also, to avoid losses, the small quantities which remain in the filters first used, must be placed on fresh filters. Afterwards all the filters should be compressed in a cloth, to separate the water from them. Those which contain a comparatively consi-

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derable portion of manganese, become so hot as to burn the hand.

7. The fluid which now contains only hydro-chloric acid, water, and oxygen, is placed in the glass it was first prepared in, and its temperature lowered by ice, as before. Then, stirring it continually, sulphate of silver, prepared by dissolving oxide of silver in sulphuric acid, is to be added, by small quantities at a time; and it is essential that the sulphate contains no free oxide. The sulphate is decomposed by the hydro-chloric acid, and there results water, chloride of silver which precipitates, and sulphuric acid in place of the hydro-chloric. When the quantity of sulphate of silver added is sufficient to decompose perfectly all the hydro-chloric acid, the fluid suddenly becomes clear; until that is the case, it remains turbid. As it is required that no hydro-chloric acid should remain, so also no excess of sulphate of silver should be present; and, therefore, the fluid must be tested successively by nitrate of silver and muriatic acid, very small quantities of the fluid being used for this purpose.

When the proportions are well adjusted, the fluid is to be passed through a filter, and the filter, after being allowed to drain, is to be compressed in a cloth. The fluid obtained by the compression, must be again passed through a filter, in consequence of a slight degree of turbidness.

8. The object of the preceding operations has been to obtain a fluid composed of water, oxygen, and sulphuric acid. But this acid must be separated; for this purpose the fluid is put into a glass mortar, surrounded by ice, and slaked barytes, very pure and finely powdered, is to be added by small portions at a time; it is to be rubbed again in the glass mortar, and when it is all united to the acid a fresh portion is to be added. When the fluid scarcely reddens litmus paper it is to be filtered, and the filter compressed in a cloth; then after having united the two fluids they are to be stirred, and the saturation of the acid completed by barytes water. There must even be a slight excess of barytes water added to separate all traces of iron; and, above all, of manganese, which the fluid may still contain; and it is of importance to remember, that it must be filtered imme-

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diately after, with all the precautions before given. The excess of barytes may then be precipitated by a few drops of weak sulphuric acid, and it is better to leave a slight excess of the acid present, rather than of the base, because the last tends to disengage oxygen, whilst the first renders the combination more permanent.

9. Finally, the fluid, which may be considered as pure oxygenated water, diluted with common water, is to be put into a clean glass having a foot, and this glass placed in a large capsule, two-thirds full of concentrated sulphuric acid. This apparatus is to be placed in the receiver of an air-pump, and a vacuum made. Pure water having a greater tension when in vapour, than oxygenated water, evaporates more rapidly, so that at the end of two days the fluid will contain perhaps two hundred and fifty times its volume of oxygen. The following observations must be attended to:

The acid must be agitated from time to time.

It happens sometimes that, towards the end of the evaporation, the fluid disengages a little gas, which is indicated by the variation of the mercury in the gauge. This disengagement is occasioned, no doubt, by extraneous substances which remain in the fluid; it may be stopped by the addition of two or three drops of extremely dilute sulphuric acid.

Sometimes the fluid will deposit some white flocculi of silex. This should be separated. The fluid may be decanted by a pipe with a very fine termination, and but a small quantity of it will be lost.

Until the fluid becomes very concentrated the evaporation goes on very quietly, but when the oxygenated water scarcely contains any more water, bubbles frequently rise, which burst with difficulty. At first sight, it seems as if much oxygen gas escaped, but on examining the gauge, it will appear very trifling. It will scarcely become sensible in twenty-four hours, and the alteration then observed is in part occasioned by the disengagement of gas from the sulphuric acid, belonging to a portion of the oxygenated water which has been evaporated.

The fluid may be known to be in the most concentrated state possible, when it gives four hundred and seventy-five times its

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volume of oxygen at the pressure of 0m 76 (30 inches nearly,) and temperature of 14° (57.2 Fahr.) This proof is readily made by taking a small tube, on which a line is marked, and filling it with the fluid up to the line, and then diluting this quantity, which, in my experiments, was always $\frac{5}{100}$ of a centilitre, (0,030514 of c : i :) with twelve times its volume of water, and decomposing a certain quantity of this last fluid by oxide of manganese. This last experiment consists in filling a tube 15 or 16 inches long, and 7 or 8 lines wide, with mercury to within an inch of the top; then introducing the portion of diluted fluid, of which the analysis is to be made, using for this purpose a small tube of known capacity, afterwards filling the tube with the water used to wash the small measure, or partly with mercury, and then, by closing the tube with a valve, covered with tallow, inverting it, and passing in a little oxide of manganese diffused in water. The oxygen will be immediately disengaged, and nothing further is required than to close the tube with the hand, and shake it in different directions, that the contact of the oxide of manganese and the water may be ensured, and to measure the gas.

Annales de Chim. xi. p. 208.

ART. X. *Description of* Messrs. TAYLORS AND MARTINEAU'S *Patent Apparatus, for the production of Gas from Oil, &c.*

THE annexed engraving (Plate I.) represents a complete double apparatus, such as has lately been erected at Apothecaries' Hall, London; and includes all the improvements which have been suggested by the experience of the inventors, from the extended use of them in various places.

A general idea of the process may be formed from the following account of it:—

A quantity of oil is placed in an air-tight vessel, in such a manner, that it may flow into retorts which are kept at a moderate red heat: and in such proportions as may regulate the produc-

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tion of gas to a convenient rate; and it is provided, that this rate may be easily governed at the will of the operator.

The oil, in its passage through the retorts, is principally decomposed, and converted into gas proper for illumination, having the great advantages of being pure and free from sulphurous contamination, and of supporting a very brilliant flame, with the expenditure of very small quantities. It will, however, generally be found that some oil passes off in the state of vapour, without being decomposed; and in order to condense this, and return it again into the oil vessel, the gas is made to pass through a vessel immersed in water, by which, and its exit by a worm, the vapour is condensed again into oil, and flows at once into the oil cistern, so as to come again into use in the retorts.

As a further precaution to purify the gas from oil, which may be suspended in it in the state of vapour, it is conveyed into a wash vessel, where by bubbling through water, it is further cooled and rendered fit for use; and passes by a proper pipe into a gazometer, from which it is suffered to branch off in pipes in the usual manner.

The apparatus, of which the annexed engraving is a representation, is fit for a large establishment, and would be capable of producing from 1,600 to 1,800 cube feet of gas at one operation; or without cleaning out the retorts, which becomes necessary from time to time from the accumulation of a certain quantity of carbonaceous matter. This, and the necessary attention to keep up a moderate fire, is the only trouble which attends the use of the apparatus, and the time required for the production of the above quantity, would in general be about six hours.

The number of lights which would be supplied by 1,800 cube feet of oil gas, reckoning that they were argand burners, and employed for four hours, would be about 300, and giving a light equal to from 3,000 to 3,600 mould candles.

In order to adapt them to different establishments requiring smaller quantities of light, and to fit them for private houses, or the residences of noblemen and gentlemen, Messrs. Taylor and Martineau have made them of various sizes, accommodated to different degrees of power, and suitable by the small space they

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occupy, for situations where room cannot be spared to much extent.

One which is capable of furnishing gas for from 12 to 20 argand lights, may be conveniently placed in such a fire-place as is usually found in back kitchens, and will occupy a space only of about 3 feet square, or more conveniently of 4 feet by 3, and will require a height of about 8 feet.

The large apparatus shewn in the plate measures in front 10 feet, and in depth 6 feet, and is also about 8 feet high.

The intermediate sizes are made up by adopting either one stove of the large or smaller sizes to its proper feeding and washing apparatus; or by fixing two stoves, of such dimensions as may be required to a common feeding apparatus, as shewn in the plate.

The latter plan is the best, as it is a security against any disappointment, for as the stoves may thus be worked either singly or together, it gives the power of cleaning or putting the one in order, without any hinderance to the process.

The space mentioned as occupied by this gas apparatus is, of course, independent of that necessary for the gazometer, or reservoir of gas, which is variable according to the consumption required.

For private houses, a gazometer should hardly contain less than from 80 to 100 cube feet, and for mansions and larger establishments they should hold from 300 to 600 cube feet. There are great advantages in having the gazometer as large as circumstances will admit; in the first place, the demand of the longest night in winter should be provided for, and the increased consumption occasioned by lighting the greatest number of rooms for company. In the second place, both the trouble and expense of the gas is diminished by having a reservoir sufficiently capacious to hold some days' ordinary consumption, by which, as the gas improves by keeping, it is most convenient and economical to have to make it but occasionally, as, for instance, once or twice in the week.

In a moderate private house, where three or four rooms are adequately lighted, and where a small flame is kept burning all

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night in a bed-chamber, it has been found that from 20 to 30 cube feet of oil-gas is sufficient; and, therefore, a gazometer containing 100 feet will give a supply for four nights.

Such a gazometer will be about 6 feet long and 4 wide, and rather more than 4 feet high. One for 400 cube feet may be 10 feet long, and 7 wide, and about 6 high, and larger ones, of course, in proportion.

There is no occasion that a gazometer should be placed near the other parts of the apparatus, though they are, for the convenience of description, so exhibited in the plate; and, indeed, at Apothecaries' Hall, from which the drawing has been made, the gazometer is not so placed, but is at a distance in the yard, where it was originally fixed and used for coal-gas. No inconvenience arises from the gazometer being apart from the rest, and it allows of placing them out of the main building, either in any yard or out-building that may be at hand.

Description of the Oil-gas Apparatus.

AA (Plate I.) Figure 1, Stoves made of cast iron, and lined with brick-work, containing the retorts.

a Doors to get at the retort mouths for cleansing them.

b Fire door. *c* Ash-pit.

B Iron-stand, or frame, supporting the condenser, oil-cistern, and wash vessel.

C Oil-cistern. D Cock, to permit the oil to enter the cistern by the funnel E, or, by turning it in another direction, to flow into the retorts by the pipe F.

d d Small index cocks, to govern the admission of the oil in the retorts.

These parts are shown upon a larger scale in Fig. 2.

GG Perforated columns, by which the oil descends to the retorts.

HH Perforated columns, by which the gas ascends from the retorts, and is carried by the moveable pipe I, to the condenser in the case J. This case is filled with cold water, surrounding the condenser.

The columns are fitted with stoppers on their tops, which are easily taken out for the convenience of cleaning.

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K A short pipe, communicating from the bottom of the condenser to the top of the oil-cistern; this conveys the condensed oil at once into the latter, and suffers the surface of the fluid in it to be acted upon by the same pressure as exists at all times in the retorts.

L A pipe to convey the gas from the condenser to the wash-vessel M.

e Screw plug, to allow water to be poured into the wash vessel.

f A cock to draw water from the wash vessel.

g A cock to regulate the height of water in the wash vessel, and to draw off condensed oil, as it may occasionally accumulate there.

N Pipe to convey the gas from the wash vessel to the gazometer.

O Plate II., Pipe rendered flexible by knuckle-joints, to convey the gas into the gazometer at the top.

P A similar pipe, leading the gas to the tubes, which conduct it to the burners.

Q Gazometer made of sheet-iron, and suspended by a chain over pulleys, with a counterpoise. It is placed in water in the usual manner, which may be contained in a brick tank, or in a cistern of wood or cast-iron, as circumstances may render most convenient.

Art. XI. *Some Account of the Character and Merits of the late* Professor Playfair.

[We regret that it has not been in our power to obtain materials for a more extended account of the two eminent persons, whose Biography is sketched in this and the succeeding article, and are not without hopes of accomplishing this on a future occasion. In the mean time, we have thought well to insert the following notices, which originally appeared in the *Times* newspaper, and which are from the pen of a very spirited writer.]

It has struck many people, we believe, as very extraordinary, that so eminent a person as Mr. Playfair should have been allowed to sink into his grave in the midst of us, without

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calling forth almost so much as an attempt to commemorate his merit, even in a common newspaper; and that the death of a man so eminent and so beloved, and, at the same time, so closely connected with many who could well appreciate and suitably describe his excellencies, should be left to the brief and ordinary notice of the daily obituary. No event of the kind certainly ever excited more general sympathy; and no individual, we are persuaded, will be longer or more affectionately remembered by all the classes of his fellow-citizens; and yet it is to these very circumstances that we must look for an explanation of the apparent neglect by which his memory has been followed. His humbler admirers have been deterred from expressing their sentiments by a natural feeling of unwillingness to encroach on the privilege of those, whom a nearer approach to his person and talents rendered more worthy to speak of them; while the learned and eloquent among his friends have trusted to each other for the performance of a task which they could not but feel to be painful in itself, and not a little difficult to perform as it ought to be; or, perhaps, have reserved for some more solemn occasion that tribute for which the public impatience is already at its height.

We beg leave to assure our readers, that it is merely from anxiety to do *something* to gratify this natural impatience, that we presume to enter at all upon a subject to which we are perfectly aware that we are incapable of doing justice; for of Mr. Playfair's scientific attainments, of his proficiency in those studies to which he was peculiarly devoted, we are but slenderly qualified to judge: but, we believe, we hazard nothing in saying that he was one of the most learned mathematicians of his age, and among the first, if not the very first, who introduced the beautiful discoveries of the latter continental geometers to the knowledge of his countrymen, and gave their just value and true place in the scheme of European knowledge to those important improvements by which the whole aspect of the abstract sciences has been renovated since the days of our illustrious Newton. If he did not signalize himself by any brilliant or original invention, he must at least, be allowed to have

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been a most generous and intelligent judge of the achievements of others, as well as the most eloquent expounder of that great and magnificent system of knowledge which has been gradually evolved by the successive labours of so many gifted individuals. He possessed, indeed, in the highest degree, all the characteristics both of a fine and powerful understanding, at once penetrating and vigilant, but more distinguished, perhaps, for the caution and sureness of its march, than for the brilliancy or rapidity of its movements, and guided and adorned through all its progress by the most genuine enthusiasm for all that is grand, and the justest taste for all that is beautiful in the truth or the intellectual energy with which he was habitually conversant.

To what account these rare qualities might have been turned, and what more brilliant or lasting fruits they might have produced, if his whole life had been dedicated to the solitary cultivation of science, it is not for us to conjecture; but it cannot be doubted that they added incalculably to his eminence and utility as a teacher; both by enabling him to direct his pupils to the most simple and luminous methods of inquiry, and to imbue their minds, from the very commencement of the study, with that fine relish for the truths it disclosed, and that high sense of the majesty with which they were invested, that predominated in his own bosom. While he left nothing unexplained or unreduced to its proper place in the system, he took care that they should never be perplexed by petty difficulties, or bewildered in useless details, and formed them betimes to that clear, masculine, and direct method of investigation, by which, with the least labour, the greatest advances might be accomplished.

Mr. Playfair, however, was not merely a teacher; and has fortunately left behind him a variety of works, from which other generations may be enabled to judge of some of those qualifications which so powerfully recommended and endeared him to his contemporaries. It is, perhaps, to be regretted, that so much of his time, and so large a proportion of his publications, should have been devoted to the subjects of the Indian astronomy, and

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the Huttonian theory of the earth. For though nothing can be more beautiful or instructive than his speculations on those curious topics, it cannot be dissembled that their results are less conclusive and satisfactory than might have been desired; and that his doctrines, from the very nature of the subjects, are more questionable than we believe they could possibly have been on any other topic in the whole circle of the sciences. To the first, indeed, he came under the great disadvantages of being unacquainted with the Eastern tongues, and without the means of judging of the authenticity of the documents which he was obliged to assume as the elements of his reasonings; and as to the other, though he ended, we believe, with being a very able and skilful mineralogist, we think it is now generally admitted, that that science does not yet afford sufficient materials for any positive conclusion; and that all attempts to establish a theory of the earth, must, for many years to come, be regarded as premature. Though it is impossible, therefore, to think too highly of the ingenuity, the vigour, and the eloquence of those publications, we are of opinion, that a juster estimate of Mr. Playfair's talent, and a truer picture of his genius and understanding, is to be found in his other writings; in the papers both biographical and scientific, with which he has enriched the Transactions of our Royal Society; his account of De Laplace, and other articles which he is understood to have contributed to the *Edinburgh Review;* the outlines of his lectures on Natural Philosophy; and, above all, his Introductory Discourse to the Supplement to the *Encyclopædia Britannica*, with the final correction of which he was occupied up to the last moments that the progress of his disease allowed him to dedicate to any intellectual exertion.

With reference to these works, we do not think we are influenced by any national or other partiality, when we say that he was certainly one of the best writers of his age; and even that we do not now recollect any one of his contemporaries who was so great a master of composition. There is a certain mellowness and richness about his style, which adorns, without disguising, the weight and nervousness which is its other great character-

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istic; a sedate gracefulness and manly simplicity in the more level passages, and a mild majesty and considerate enthusiasm where he rises above them, of which we scarcely know where to find any other example. There is great equability, too, and sustained force in every part of his writings. He never exhausts himself in flashes and epigrams, nor languishes into tameness or insipidity; at first sight you would say that plainness and good sense were the predominating good qualities; but, by and by, this simplicity is enriched with the delicate and vivid colours of a fine imagination; the free and forcible touches of a most powerful intellect; and the lights and shades of an unerring and harmonizing taste. In comparing it with the styles of his most celebrated contemporaries, we would say that it was more purely and peculiarly a written style, and therefore rejected those ornaments that more properly belong to oratory. It had no impetuosity, hurry, or vehemence—no bursts or sudden turns or abruptions, like that of Burke; and though eminently smooth and melodious, it was not modulated to an uniform system of solemn declamation, like that of Johnson, nor spread out in the richer and more voluminous elocution of Stewart; nor still less broken into the patch-work of scholastic pedantry and conversational smartness which has found its admirers in Gibbon. It is a style, in short, of great freedom, force, and beauty; but the deliberate style of a man of thought and of learning; and neither that of a wit throwing out his extempores with an affectation of careless grace, or of a rhetorician, thinking more of his manner than his matter, and determined to be admired for his expression, whatever may be the fate of his sentiments.

His habits of composition, as we have understood, were not, perhaps, exactly what might have been expected from their results. He wrote rather slowly, and his first sketches were often very slight and imperfect, like the rude chalking of a masterly picture. His chief effort and greatest pleasure were in their revisal and correction; and there were no limits to the improvement which resulted from this application. It was not the style merely, or indeed chiefly, that gained by it. The whole

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reasoning, and sentiment, and illustration, were enlarged and new modelled in the course of it, and a naked outline became gradually informed with life, colour, and expression. It was not at all like the common finishing and polishing to which careful authors generally subject the first draughts of their compositions, not even like the fastidious and tentative alterations with which some more anxious writers essay their choicer passages. It was, in fact, the great filling in of the picture, the working up of the figured weft on the naked and meagre woof that had been stretched to receive it; and the singular thing in this case was, not only that he left this most material part of his work to be performed after the whole outline had been finished, but that he could proceed with it to an indefinite extent, and enrich and improve as long as he thought fit, without any risk either of destroying the proportions of that outline, or injuring the harmony and unity of the design. He was perfectly aware, too, of the possession of this extraordinary power, and it was partly, we presume, in consequence of it, that he was not only at all times ready to go on with any work in which he was engaged, without waiting for favourable moments or hours of greater alacrity, but that he never felt any of those doubts and misgivings as to his being able to get creditably through with his undertaking, to which, we believe, most authors are occasionally liable. As he never wrote upon any subject of which he was not perfectly master, he was secure against all blunders in the substance of what he had to say, and felt quite assured, that if he was only allowed time enough, he should finally come to say it in the very best way of which he was capable. He had no anxiety, therefore, either in undertaking or proceeding with his tasks, and intermitted and resumed them at his convenience, with the comfortable certainty that all the time he bestowed on them was turned to good account, and that what was left imperfect at one sitting, might be finished with equal ease and advantage at another. Being thus perfectly sure both of his ends and his means, he experienced in the course of his compositions none of that little fever of the spirits with which that operation is so apt to be accompanied. He had no capricious

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visitings of fancy, which it was necessary to fix on the spot, or to lose for ever; no casual inspiration to invoke and to wait for; no transitory and evanescent lights to catch before they faded. All that was in his mind was subject to his control, and amenable to his call, though it might not obey at the moment; and while his taste was so sure that he was in no danger of overworking any thing that he had designed, all his thoughts and sentiments had that unity and congruity, that they fell almost spontaneously into harmony and order; and the last added, incorporated, and assimilated with the first, as if they had sprung simultaneously from the same happy conception.

But we need dwell no longer on qualities that may be gathered hereafter from the works he has left behind him. They who lived with him mourn the most for those which will be traced in no such memorial; and prize far above those talents which gained him his high name in philosophy, that personal character which endeared him to his friends, and shed a grace and dignity over all the society in which he moved. The same admirable taste which is conspicuous in his writings, or rather the higher principles from which that taste was but an emanation, spread a similar charm over his whole life and conversation; and gave to the most learned philosopher of his day the manners and deportment of the most perfect gentleman. Nor was this in him the result merely of good sense and good temper, assisted by an early familiarity with good company, and consequent knowledge of his own place and that of all around him; his good breeding was of a higher descent, and his powers of pleasing rested on something better than mere companionable qualities. With the greatest kindness and generosity of nature, he united the most manly firmness, and the highest principles of honour;—and the most cheerful and social dispositions, with the gentlest and steadiest affections. Towards women he had always the most chivalrous feelings of regard and attention, and was, beyond almost all men, acceptable and agreeable in their society,—though without the least levity or pretension unbecoming his age or condition: and such, indeed, was the fascination of the perfect

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simplicity and mildness of his manners, that the same tone and deportment seemed equally appropriate in all societies, and enabled him to delight the young and the gay with the same sort of conversation which instructed the learned and the grave. There never, indeed, was a man of learning and talent who appeared in society so perfectly free from all sorts of pretension or notion of his own importance, or so little solicitous to distinguish himself, or so sincerely willing to give place to every one else. Even upon subjects which he had thoroughly studied, he was never in the least impatient to speak, and spoke at all times without any tone of authority; while, so far from wishing to set off what he had to say by any brilliancy or emphasis of expression, it seemed generally as if he had studied to disguise the weight and originality of his thoughts under the plainest form of speech, and the most quiet and indifferent manner: so that the profoundest remarks and subtilest observations were often dropped, not only without any solicitude that their value should be observed, but without any apparent consciousness that they possessed any. Though the most social of human beings, and the most disposed to encourage and sympathize with the gaiety and joviality of others, his own spirits were in general rather cheerful than gay, or at least never rose to any turbulence or tumult of merriment; and while he would listen with the kindest indulgence to the more extravagant sallies of his younger friends, and prompt them by the heartiest approbation, his own satisfaction might generally be traced in a slow and temperate smile, gradually mantling over his benevolent and intelligent features, and lighting up the countenance of the sage with the expression of the mildest and most genuine philanthropy. It was wonderful, indeed, considering the measure of his own intellect, and the rigid and undeviating propriety of his own conduct, how tolerant he was of the defects and errors of other men. He was too indulgent, in truth, and favourable to his friends, and made a kind and liberal allowance for the faults of all mankind, except only faults of baseness or of cruelty, against which he never

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failed to manifest the most open scorn and detestation. Independent, in short, of his high attainments, Mr. Playfair was one of the most amiable and estimable of men, delightful in his manners, inflexible in his principles, and generous in his affections; and while his friends enjoyed the free and unstudied conversation of an easy and intelligent associate, they had at all times the proud and inward assurance that he was a being upon whose perfect honour and generosity they might rely with the most implicit confidence, in life and in death; and of whom it was equally impossible, that, under any circumstances, he should ever perform a mean, a selfish, or a questionable action, as that his body should cease to gravitate or his soul to live.

If we do not greatly deceive ourselves, there is nothing here of exaggeration or partial feeling, and nothing with which an indifferent and honest chronicler would not concur. Nor is it altogether idle to have dwelt so long on the personal character of this distinguished individual: for we are ourselves persuaded that this personal character has almost done as much for the cause of science and philosophy among us as the great talents and attainments with which it was combined, and has contributed in a very eminent degree, to give to the better society of this our city that tone of intelligence and liberality by which it is so honourably distinguished. It is not a little advantageous to philosophy that it is in fashion; and it is still more advantageous, perhaps, to the society which is led to confer on it this apparently trivial distinction. It is a great thing for the country at large—for its happiness, its prosperity, and its renown, that the upper and influencing part of its population should be made familiar, even in its untasked and social hours, with sound and liberal information, and be taught to know and respect those who have distinguished themselves for great intellectual attainments. Nor is it, after all, a slight or despicable reward for a man of genius to be received with honour in the highest and most elegant society around him, and to receive in his living person that homage and applause which is too often reserved for his memory. Now, those desirable ends can never

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be effectually accomplished, unless the manners of our leading philosophers are agreeable, and their personal habits and dispositions engaging and amiable. From the time of Hume and Robertson, we have been fortunate in Edinburgh in possessing a succession of distinguished men, who have kept up this salutary connexion between the learned and the fashionable world; but there never, perhaps, was any one who contributed so powerfully to confirm and extend it, and that in times when it was peculiarly difficult, as the lamented individual of whom we are now speaking; and they who have had the most opportunity to observe how superior the society of Edinburgh is to that of most other places of the same size, and how much of that superiority is owing to the cordial combination of the two aristocracies, of rank and of letters—of both of which it happens to be the chief provincial seat—will be best able to judge of the importance of the service he has thus rendered to its inhabitants, and, through them, and by their example, to all the rest of the country.

In thus mournfully estimating the magnitude of the loss we have sustained, it is impossible that our thoughts should not be turned to the likelihood of its being partly supplied by the appointment of a suitable successor. That it should be wholly supplied, even with a view to the public, we confess we are not sanguine enough to expect. That our professor of mathematics and natural philosophy should have been for more than 30 years, not only one of the most celebrated mathematicians, but one of the finest writers, and one of the highest-bred gentlemen of his age, is a felicity which it is out of all calculation that we should so soon experience again: but, in an age when—very much by his efforts and example—several men of great and distinguished eminence in science can be found, and, as we understand, have already proposed themselves for the vacancy, we do trust that the chair of Mr. Playfair, or any other chair which his death may ultimately leave vacant, will not be bestowed upon a person of questionable or even ordinary attainments.

The object of such an appointment is, no doubt, to instruct youth in the elements of knowledge; but it is, notwithstanding,

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a most gross mistake to suppose that a capacity to teach these elements is a sufficient qualification for the office of an Edinburgh professor. If it were so, every second lad who had passed creditably through such a class in one year, might be properly appointed to teach it the year after. Nobody, however, will maintain any thing so absurd as this; and though we fear that the duties of those who are vested with the right of nomination have not always been correctly understood, no such monstrous misconception can require to be obviated. We have unfortunately in this country but too few desirable situations wherewith to reward the successful cultivators of the abstract sciences. The prizes in their lottery are lamentably few; and it would be the height of injustice not to let them have them all. If it be of importance to a country (and it is in every respect of the very first importance) that it should possess men eminent for genius and science, it is of importance that it should encourage them; and it is obvious that no encouragement can be so effectual, so cheap, and so honourable, as sacredly to reserve, and impartially to assign, to them, in proportion to their eminence, those situations of high honour and moderate emolument to which it is their utmost ambition to aspire, and which gives them not only the rank and dignity they have so worthily earned, but the means of cultivating and diffusing, with great additional effect, that very knowledge to which their years have been devoted. On this ground alone the duty of giving to men distinguished for science, and devoted to it, the few scientific professorships that are established among us, appears to be absolutely imperative, on the score of mere justice, as well as of national advantage; on that of national honour, it is not of less cogency. We have once more made ourselves a name as a scientific nation in every quarter of the world; and, by means of Playfair and Leslie, the Scottish philosophy of physics is nearly as well known all over the civilized world as the Scottish philosophy of mind. The Edinburgh school of science now maintains a rivalry with the most celebrated of those in England; and among foreign philosophers, the name of Playfair is more honoured and better known than that of any of the *alumni* of Cambridge. But is this

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honour, do we think, to be maintained by placing in his chair an obscure or an ordinary teacher? a man capable of instructing boys in Euclid and algebra, and fit enough to teach mathematics or natural philosophy in a provincial academy, but without knowledge of the higher parts of the science, and without genius to enlarge its boundaries, or to grapple, at least, with their resistance? While there are men of eminence and genius to be found and Scotch bred men, too, of this description, willing and anxious as they are able, to maintain the honour of their country and their school, we trust that no such disgrace will be put on Scotland and Edinburgh on this critical and important occasion.

If lower and more selfish considerations were wanting, they, too, all lead to the same conclusion. An ordinary schoolmaster cannot, in fact, teach ordinary schooling so well as a superior person; but, even if he could, he would never attract the same resort of pupils; and the celebrity of the teachers, therefore, is a necessary condition of the greatness of the classes, the increase of the emoluments, and the general resort of families for education—to spend money and pay taxes within the extended royalty.

Perhaps the patronage of such chairs might have been better placed than in the magistracy of Edinburgh. But we are inclined to augur well of their conduct on this occasion. For a good while back they have discharged this important part of their duty uprightly and well; and seem to have a proper sense of the importance of resisting all sinister influence in those interesting nominations. At this moment, too, they probably feel that they have not much popularity to spare; and, upon the whole, we have much more fear of their being misled than of their going voluntary astray. The few considerations we have now thrown out may help, perhaps, to keep them right; and, indeed, they can scarcely go wrong, if they remember, first, that a person qualified to teach the elements of science, but without a name, or a chance of acquiring a name amongst its votaries, is not fit to be placed at the head of the whole science of Scotland, by being appointed to the first, or the second, scientific professorship in this metropolitan university; and secondly, that

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the chair now to be filled is a chair of science, and ought not to be made the reward of any other than scientific eminence.

Art. XII. *Biographical Memoir of the late* Mr. James Watt.

Death is still busy in our high places; and it is with great pain that we find ourselves called upon, so soon after the loss of Mr. Playfair, to record the decease of another of our illustrious countrymen, and one to whom mankind has been still more largely indebted. Mr. James Watt, the great improver of the steam-engine, died on the 25th of August, at his seat of Heathfield, near Birmingham, in the 84th year of his age.

This name, fortunately, needs no commemoration of ours; for he that bore it survived to see it crowned with undisputed and unenvied honours; and many generations will probably pass away before it shall have "gathered all its fame." We have said that Mr. Watt was the great *improver* of the steam-engine; but, in truth, as to all that is admirable in its structure, or vast in its utility, he should rather be described as its *inventor*. It was by his inventions that its action was so regulated as to make it capable of being applied to the finest and most delicate manufactures, and its power so increased as to set weight and solidity at defiance. By his admirable contrivances, it has become a thing stupendous alike for its force and its flexibility; for the prodigious power which it can exert, and the ease, and precision, and ductility, with which they can be varied, distributed, and applied. The trunk of an elephant that can pick up a pin or rend an oak is nothing to it. It can engrave a seal, and crush masses of obdurate metal like wax before it; draw out, without breaking, a thread as fine as a gossamer, and lift a ship of war like a bauble in the air. It can embroider muslin and forge anchors, cut steel into ribands, and impel loaded vessels against the fury of the winds and waves.

It would be difficult to estimate the value of the benefits which these inventions have conferred upon the country. There is no

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branch of industry that has not been indebted to them; and in all the most material, they have not only widened most magnificently the field of its exertions, but multiplied a thousand-fold the amount of its productions. It is our improved steam-engine that has fought the battles of Europe, and exalted and sustained, through the late tremendous contest, the political greatness of our land. It is the same great power which now enables us to pay the interest of our debt, and to maintain the arduous struggle in which we are still engaged, with the skill and capital of countries less oppressed with taxation. But these are poor and narrow views of its importance. It has increased indefinitely the mass of human comforts and enjoyments, and rendered cheap and accessible all over the world the materials of wealth and prosperity. It has armed the feeble hand of man, in short, with a power to which no limits can be assigned, completed the dominion of mind over the most refractory qualities of matter, and laid a sure foundation for all those future miracles of mechanic power which are to aid and reward the labours of after generations. It is to the genius of one man too that all this is mainly owing; and certainly no man ever before bestowed such a gift on his kind. The blessing is not only universal, but unbounded; and the fabled inventors of the plough and the loom, who were deified by the erring gratitude of their rude contemporaries, conferred less important benefits on mankind than the inventor of our present steam-engine.

This will be the fame of Watt with future generations; and it is sufficient for his race and his country. But to those to whom he more immediately belonged, who lived in his society and enjoyed his conversation, it is not perhaps the character in which he will be most frequently recalled—most deeply lamented—or even most highly admired. Independently of his great attainments in mechanics, Mr. Watt was an extraordinary, and in many respects a wonderful man. Perhaps no individual in his age possessed so much and such varied and exact information,—had read so much, or remembered what he had read so accurately and so well. He had infinite quickness of apprehension, a prodigious memory, and a certain rectifying and methodising

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power of understanding, which extracted something precious out of all that was presented to it. His stores of miscellaneous knowledge were immense,—and yet less astonishing than the command he had at all times over them. It seemed as if every subject that was casually started in conversation with him, had been that which he had been last occupied in studying and exhausting; such was the copiousness, the precision, and the admirable clearness of the information which he poured out upon it without effort or hesitation. Nor was this promptitude and compass of knowledge confined in any degree to the studies connected with his ordinary pursuits. That he should have been minutely and extensively skilled in chemistry and the arts, and in most of the branches of physical science, might, perhaps, have been conjectured; but it could not have been inferred from his usual occupations, and probably is not generally known, that he was curiously learned in many branches of antiquity, metaphysics, medicine, and etymology, and perfectly at home in all the details of architecture, music, and law. He was well acquainted too with most of the modern languages, and familiar with their most recent literature. Nor was it at all extraordinary to hear the great mechanician and engineer detailing and expounding, for hours together, the metaphysical theories of the German logicians, or criticising the measures or the matter of German poetry.

His astonishing memory was aided, no doubt, in a great measure, by a still higher and rarer faculty—by his power of digesting and arranging in its proper place all the information he received, and of casting aside and rejecting, as it were instinctively, whatever was worthless or immaterial. Every conception that was suggested to his mind seemed instantly to take its place among its other rich furniture, and to be condensed into the smallest and most convenient form. He never appeared, therefore, to be at all encumbered or perplexed with the *verbiage* of the dull books he perused, or the idle talk to which he listened; but to have at once extracted, by a kind of intellectual alchemy, all that was worthy of attention, and to have reduced it for his own use, to its true value and to its simplest form. And thus it

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often happened that a great deal more was learned from his brief and vigorous account of the theories and arguments of tedious writers, than an ordinary student could ever have derived from the most faithful study of the originals; and that errors and absurdities became manifest from the mere clearness and plainness of his statement of them, which might have deluded and perplexed most of his hearers without that invaluable assistance.

It is needless to say, that with those vast resources, his conversation was at all times rich and instructive in no ordinary degree; but it was, if possible, still more pleasing than wise, and had all the charms of familiarity, with all the substantial treasures of knowledge. No man could be more social in his spirit, less assuming or fastidious in his manners, or more kind and indulgent towards all who approached him. He rather liked to talk, at least in his latter years; but though he took a considerable share of the conversation, he rarely suggested the topics on which it was to turn, but readily and quietly took up whatever was presented by those around him, and astonished the idle and barren propounders of an ordinary theme, by the treasures which he drew from the mine which they had unconsciously opened. He generally seemed, indeed, to have no choice or predilection for one subject of discourse rather than another, but allowed his mind, like a great cyclopedia, to be opened at any letter his associates might choose to turn up, and only endeavoured to select from his inexhaustible stores what might be best adapted to the taste of his present hearers. As to their capacity, he gave himself no trouble; and, indeed, such was his singular talent for making all things plain, clear, and intelligible, that scarcely any one could be aware of such a deficiency in his presence. His talk, too, though overflowing with information, had no resemblance to lecturing or solemn discoursing, but, on the contrary, was full of colloquial spirit and pleasure. He had a certain quiet and grave humour, which ran through most of his conversation, and a vein of temperate jocularity, which gave infinite zest and effect to the condensed and inexhaustible information which formed its main staple and characteristic. There was a little air of affected testiness, and a tone of pretended rebuke

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and contradiction, with which he used to address his younger friends, that was always felt by them as an endearing mark of his kindness and familiarity, and prized accordingly far beyond all the solemn compliments that ever proceeded from the lips of authority. His voice was deep and powerful, though he commonly spoke in a low and somewhat monotonous tone, which harmonized admirably with the weight and brevity of his observations, and set off to the greatest advantage the pleasant anecdotes which he delivered with the same grave brow and the same calm smile playing soberly on his lips. There was nothing of effort indeed, or impatience, any more than of pride or levity, in his demeanour; and there was a finer expression of reposing strength, and mild self-possession in his manner, than we ever recollect to have met with in any other person. He had in his character the utmost abhorrence for all sorts of forwardness, parade, and pretensions; and, indeed, never failed to put all such impostors out of countenance, by the manly plainness and honest intrepidity of his language and deportment.

In his temper and dispositions he was not only kind and affectionate, but generous, and considerate of the feelings of all around him, and gave the most liberal assistance and encouragement to all young persons who shewed any indications of talent, or applied to him for patronage or advice. His health, which was delicate from his youth upwards, seemed to become firmer as he advanced in years: and he preserved, up almost to the last moment of his existence, not only the full command of his extraordinary intellect, but all the alacrity of spirit, and the social gaiety which had illuminated his happiest days. His friends in this part of the country never saw him more full of intellectual vigour and colloquial animation, never more delightful or more instructive, than in his last visit to Scotland in autumn 1817. Indeed, it was after that time that he applied himself with all the ardour of early life, to the invention of a machine for mechanically copying all sorts of sculpture and statuary, and distributed among his friends some of its earliest performances, as the productions of a young artist just entering on his 83d year.

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This happy and useful life came at last to a gentle close. He had suffered some inconveniencies through the summer; but was not seriously indisposed till within a few weeks from his death. He then became perfectly aware of the event which was approaching; and with his usual tranquillity and benevolence of nature, seemed only anxious to point out to the friends around him the many sources of consolation which were afforded by the circumstances under which it was about to take place. He expressed his sincere gratitude to Providence for the length of days with which he had been blessed, and his exemption from most of the infirmities of age, as well as for the calm and cheerful evening of life that he had been permitted to enjoy, after the honourable labours of the day had been concluded. And thus, full of years and honours, in all calmness and tranquillity, he yielded up his soul, without pang or struggle, and passed from the bosom of his family to that of his God!

He was twice married, but has left no issue but one son, long associated with him in his business and studies, and two grandchildren by a daughter who pre-deceased him. He was a Fellow of the Royal Societies both of London and Edinburgh, and one of the few Englishmen who were elected Members of the National Institute of France. All men of learning and science were his cordial friends; and such was the influence of his mild character and perfect fairness and liberality, even upon the pretenders to these accomplishments, that he lived to disarm even envy itself, and died, we verily believe, without a single enemy.

ART. XIII. *A descriptive Account of the several Processes which are usually pursued in the manufacture of the Article known in Commerce by the name of Tin-Plate.* By Samuel Parkes, F.L.S., *&c. Abridged from a paper read before the Philosophical Society of Manchester.*

ENGLISH bar-iron of the finest quality, called tin-iron, and which is generally prepared with *charcoal* instead of mineral coke, and made with the greatest care, for this particular pur-

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pose, is first cut to the necessary length, and then rolled at the mill, by a process which is peculiar to this manufacture, into plates of the requisite thinness, and of such form as is suitable for the business. These plates are then cut by hand-shears to the sizes suitable to the different markets. And as the shearer shears the plates, he piles them in heaps, occasionally putting one plate the cross way, to keep each box separate. Two hundred and twenty-five plates are called a box, but they are not put into boxes of wood in this stage of the operation. The iron plates now go into the hands of the *scaler*, who takes them from the shear-house, and bends each of them singly across the middle, into this form Λ, preparatory to their being cleaned for tinning, and for the conveniency of putting them into the scaling furnace, as will be more fully explained hereafter.

This furnace, or oven, is heated by *flame* thrown into it from a fire-place of a peculiar construction, and it is this flame that scales the plates, which are put into the oven in rows, and arranged three in each row, until the oven is full. It will be obvious that if they lay flat on the floor of the oven, the flame could play only on one side of each plate, whereas, by being bent in the form already described, the flame can operate equally on both sides. It may here be remarked that the form of all tin-plates, one sort excepted, is that of a parallelogram, and that if a piece of stiff paper, or paste-board, 13¼ inches long, and 10 inches wide, be bent in the centre at an angle of about sixty degrees, and then put to stand on the two ends, we shall have the form of a plate No. 1. properly bent for the scaling oven.

The operation of *cleansing*, as it is called, and which is preparatory to the process of scaling, is commenced by steeping the plates for the space of four or five minutes, in a mixture of muriatic acid and water, in the proportion of four pounds of acid to three gallons of water. This quantity of the diluted acid will generally be sufficient for eighteen hundred plates, or eight boxes of 225 plates each.

When the plates have been steeped for the time prescribed, they are taken out of the liquor, and placed upon the floor, three in a row, and then by means of an iron rod put under them, they

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are conveyed to a furnace heated red-hot, where they remain until the heat takes off the scale, the removal of which was the object in submitting them to that high temperature.

When this is effected, the plates are taken to a floor, where they are suffered to cool—they are then straightened, and beaten smooth upon a cast-iron block. The workman knows by the appearance of the plates during this operation, whether they have been well scaled—for if they have, that is, if the rust or oxide which was attached to the iron, has been properly removed, they will appear mottled with blue and white, something like marbled paper. The operation we have been describing is called *scaling*.

As it is impossible the plates can go through this process without being in some measure warped, or otherwise disfigured, they are now rolled a *second* time, between a pair of cast-iron rollers, properly hardened and finely polished. This operation makes both sides of the plates perfectly smooth, and imparts a sort of polish to their surfaces. These rollers are each about 17 inches long, and 12 or 13 inches in diameter—but I am inclined to think that if the diameter was greater*, they would set the plates flatter, and do the work better in every respect.

The technical name of this apparatus is *rolls*, not *rollers*. All the rolls which are employed in rolling plates, either hot or cold, in this manufactory, are *hard* rolls—and there is as much difference between a pair of *hard* cast-iron rolls, and a pair of *soft rolls*, although they may both be run out of the same pot of metal, as there is between iron and steel. The workmen inform me that the difference is entirely occasioned by the manner of casting them—the soft rolls being cast in sand, whereas the hard rolls are formed by pouring the metal into a thick cast-iron box—and that the metal, by coming in contact with the cold box is sufficiently chilled to render the whole face of the roll entirely

* Since the above was written, I have submitted the manuscript to a gentleman who is very largely engaged in the manufacture of tin-plates, and he tells me that the cold rolls which are employed in his work, are 30 inches in diameter.

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hard. The difference in the temper of these two kinds of rolls is so great, that when they are put into the lathe to be turned perfectly true, the turnings from the one will be $\frac{1}{8}$th of an inch in thickness, whilst the turnings which come from the other are not larger than very fine needles. The temper of cast-iron thus varying according to the nature of the mould into which it is poured, is a circumstance that appears to me to be deserving of attention in the manufacture of a variety of other utensils employed in the arts.

These rollers are used without heat, but they are screwed down very close one upon the other, only leaving bare room for the plates to pass, that the utmost attainable degree of pressure may be given to them. This last operation in called COLD ROLLING.

When the plates have undergone this process, they are put one by one into troughs filled with a liquid preparation called *the lies.*

This is merely water, in which bran has been steeped for nine or ten days, until it has acquired a sufficient acidity for the purpose. The design of putting the plates into the troughs, *singly*, is, that there may be more certainty of the liquor getting between them, and both the sides of every plate being soaked alike in the lies. In this liquor they remain for ten or twelve hours standing on the edges, but they are turned, or inverted, once during that time. This operation is called *working* in the lies.

The next operation is that of steeping in a mixture of sulphuric acid and water, in proportions which vary according to the judgment of the workmen.

The trough in which this operation is conducted, is made with thick lead, and the interior is divided by partitions of lead. Each of these divisions is by the workmen called *a hole*, and each of them will contain about one box of plates. In the diluted sulphuric acid which is in the different compartments of this vessel, the plates are agitated for about an hour, or until they have become perfectly bright, and entirely free from the black spots which are always upon them when they are first immersed in it.

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Some nicety, however, is required in this operation, for if they remain too long in the acid, they will become stained, or blistered by it, as the workmen term it; but practice enables a careful operator to judge of the time when they ought to be removed. This, however, is one of the most difficult parts of the business, as few men like to work in it; though I understand that a good pickler is highly valued by his employers, and obtains great wages. It is necessary to notify that this, and the former process with the acidulated water, are both hastened by giving to those menstrua an increase of temperature—and this is effected by means of heated flues which run under each trough. Little additional heat is necessary in summer, however, as 90° or 100° of Fahrenheit is a temperature sufficiently high for either of these operations.

When the plates come out of the pickle, they are put into pure water, and scoured in it with hemp and sand, to remove any remaining oxide, or rust of iron, that may be still attached to them, for wherever there is a particle of rust, or even *dust* upon them, there the tin will not fix; and they are then put into fresh water to be there preserved for the process of tinning. The design of putting the plates into pure water, after they come out of the sours, is to prevent their becoming again oxidated—for it has been found that after these operations, they will acquire no rust, although they should be kept twelve months immersed in water.

It will be perceived that all these processes are nothing more than preparatory measures for the operation which is to succeed, *viz.*, that of TINNING.

For this purpose an iron pot is nearly filled with a mixture of *block* and *grain* tin, in a melted state; and a quantity of tallow or grease, sufficient, when melted, to cover the fluid metal to the thickness of four inches, is put to it. However, as some gentlemen may not be acquainted with the difference between *block* and *grain* tin, it may be remarked, before we proceed, that the metal known in commerce by the name of block tin, is prepared either from the mineral called *tin-stone*, or the one known in Cornwall by the name of *tin-pyrites*, whilst the article

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called *grain tin* is smelted from an ore which is found in grains called *stream tin* ore, under beds of alluvial soil, in low situations, whither in the course of ages, it has been washed from the hills by a succession of torrents of rain. The former, which is produced in the greatest abundance, is always contaminated with a portion of iron, sulphur, and other injurious substances, and is therefore only employed for common purposes—while the grain tin, which is nearly free from every impurity, and usually from twenty to thirty shillings per hundred weight dearer, is used in the processes of dyeing, and in all other cases where *pure* tin is required. I am also desirous of remarking, that, in my opinion, it would be more profitable to the proprietor of a tin-plate work, if he were to use *grain* tin alone, or grain tin mixed with that kind which is known by the name of "Refined Tin," because these kinds not only contain less dross, but they melt, as I know by my own experience, into a more fluid metal; and consequently, more would run off the plates in the operation of tinning, and less tin would be consumed. At present these manufacturers use the block and grain tin, in equal proportions.

When the tin-pot has been charged in the way above mentioned, the metal is heated from a fire-place underneath it, and by flues which go round the pot, until it is as hot as it can be made without actually inflaming the grease which swims upon its surface. The use of the grease is to preserve the tin from the action of the atmosphere, and consequently to prevent it from oxidating. By melting a little tin or lead in an iron ladle, and, when the dross is skimmed off, putting a morsel of tallow upon the metallic fluid, the effect of the tallow in cleansing the face of the metal will be evident. The workmen also say, that it increases the affinity of the iron for the tin, or, as they express it, that it makes the iron plates take the tin better.

It is curious that *burnt grease*, or any kind of empyreumatic fat, effects this purpose better than pure fresh tallow.

Another pot, which is fixed by the side of the tin-pot, is filled with grease only; and in this the prepared plates are immersed, one by one, before they are treated with the tin; and when the pot is filled with them, they are suffered to remain in it so long

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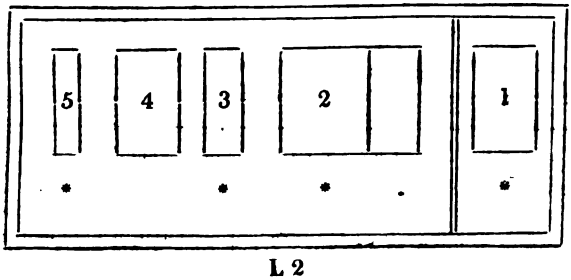
as the superintendent thinks necessary. If they remain in the grease an hour, they are found to tin better than when a shorter time is allowed them.

From this pot they are removed, with the grease still adhering to them, into the pot just before spoken of, which contains the body of melted tin; and in this they are placed in a vertical position. Three hundred and thirty-eight, or three hundred and forty plates are usually put into this pot at once; and, for the sake of their being thoroughly tinned, they usually remain in it one hour and a half; but occasionally more time is required to complete this operation.

When the plates have lain a sufficient time immersed in the melted tin, they are taken out and placed upon an iron grating, that the superfluous metal may drain from them; but, notwithstanding this precaution, when they become cold there is always more metal found adhering to them than is necessary; and this is taken off by a subsequent process, called *washing*. As this process is rather complicated, it will be necessary to describe it with some minuteness.

In the first place, the wash-man prepares an iron pot which he nearly fills with the best grain tin in a melted state—another pot of clean melted tallow, or lard free from salt—a third pot with nothing within it but a grating to receive the plates—and a fourth, called the *listing-pot*, with a little melted tin in it, about enough to cover the bottom to the depth of a quarter of an inch. The whole will, however, be better understood by referring to the following drawing, which exhibits the several vessels in the order in which they stand in the manufactory, all supported by substantial brick work.



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The building in which the pots are fixed is called the *Stow*. The plates are worked from the right to the left of the stow, as will be evident by attending to the uses of the separate pots.

No. 1. represents the tin-pot.
2. The wash-pot with the parting within it.
3. The grease-pot.
4. The pan, containing a grating at the bottom*.
5. The list-pot.

The drawing represents the *surface* of the pots. The asterisks shew the places where the workmen stand, and also mark those pots which have heated flues under them. No. 4 has no fire under it.

The parting in the wash-pot No. 2, is a late improvement. The design of it is to keep the dross of the tin from lodging in that part of the vessel where the last dip is given to the plates. By using the *common* tin in the first process of tinning, much oxide, or dross, adheres to the surface of the plates, and this runs off in the wash-pot, and comes to the face of the new metal —but this parting enables the operator to prevent it from spreading over the whole surface of the pot. Were it not for this parting, the wash-man must skim the oxide off the fluid metal every time he puts plates into it.

The pots, of which I have given a sketch, being all in a state of fitness, the wash-man commences his part of what remains of the business, by putting the plates which have undergone the various operations hitherto described into the vessel of grain-tin called the wash-pot †. The heat of this large body of melted metal soon melts all the loose tin on the surface of these plates, and so deteriorates the quality of the whole mass, that it is usual, when sixty or seventy boxes have been washed in the grain tin, to take out the quantity of a block, say three hundred weight, and replenish the wash-pot with a fresh block of pure *grain* tin. These vessels generally hold three blocks each, or about half a

* This pan is designed for the reception of the plates as the boy takes them out of the grease-pot. It has no fire underneath it.

† None but *grain* tin is ever put into this vessel, for the whole of the common tin which is consumed in such manufactories, is used in the *first* process, *viz.*, that which is called *tinning*.

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ton weight of metal. That which is taken out of the wash-pot when it is replenished with pure metal, is given to the tin-man to put into his pot.

When the plates are taken out of the wash-pot, they are carefully brushed on each side with a brush of hemp of a peculiar kind, and made expressly for the purpose. As this part of the business requires considerable adroitness and expedition, it may be worth while to explain it a little more in detail.

The wash-man first takes a few plates out of the wash-pot, and lays them together before him on the stow,—he then takes one plate up with a pair of tongs, which he holds in his left hand, and with a brush held in his right hand brushes one side of the plate,—he then turns it, and brushes the other side, and immediately dips it once more into the hot fluid metal in the wash-pot, and without letting it out of the tongs, instantly withdraws it again, and plunges it into the grease-pot (marked No. 3.) adjoining to the wash-pot from whence he had just taken it.

A person who has not seen the operation, can form but a very inadequate idea of the adroitness with which this is performed —practice, however, gives the workman so much expedition, that he is enabled to make good wages, although he obtains only three-pence for the brushing and metallic-washing of 225 plates. I am informed that an expert wash-man, if he makes the best of his time, will wash 25 boxes, consisting of 5,625 plates in twelve hours; notwithstanding every plate must be brushed on both sides, and dipped twice into the pot of melted tin.

Why the plates should be dipped *twice* during this part of their manufacture, may perhaps require some explanation. It must be recollected that they are brushed quite hot, and before the tin is set, therefore, if they had not the last dip, the marks of the brush would be visible. Moreover, the brush takes the greatest part of the tin off them, so that if they were removed to the grease-pot without being re-dipped, the hot grease would take off what remained.

The only use of the grease-pot is to take off any superfluous metal that may be upon the plates—but this is an operation that requires great attention, because, as the plate is immersed in the

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grease while the tin is in a melting, or at least in a soft, state upon it, a part *must run* off, and the remainder become less and less while the plate continues in it; therefore, if these plates should ever be left in the melted tallow longer than is absolutely necessary, they will doubtless require to be dipped a third time in the tin. On the other hand, if the plates were to be finished without passing through the grease, they would retain too much of the tin, which would be a loss to the manufacturer, and besides, the whole of the tin would appear to be in *waves* upon the iron.

It is also equally necessary to attend to the temperature of the melted tallow, which must be colder or hotter in proportion as the plates are thicker or thinner; for if, when the tallow is of a proper temperature for a thin plate, a thick one was to be put into it, it would come out, not of the colour of tin as it ought to be, but as yellow as gold. The reason of this is evident. The thick plate contains more heat than a thin one, and consequently requires the tallow to be at a lower temperature. On the contrary, if a parcel of *thin* plates were to be worked in a pot of tallow which had been prepared for *thick* plates, such a pot would not be hot enough to effect the intended purpose.

It is a common observation that, in most of our manufactures, and in all chemical speculations, theory and practice are generally at variance; but there are few manufactures, perhaps, where there are so many minutiæ which would escape the notice of a casual observer, and yet that require to be carefully attended to, in order to produce a good result, as in that which we have now been describing—and should the perusal of this paper occasion but one individual to pause, who was about to enter into a new concern with which he was only partially acquainted, I shall have written to a good purpose.

But to return to the process. When the plates are sufficiently brushed, they are again immersed, one by one, in the pot of melted tin, as has already been remarked, and immediately from this they are put into the pot of tallow above-mentioned. This pot has pins fixed within it, in such a manner as to prevent the plates from touching each other; and this part of the process is conducted in the following manner:

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When the wash-man has passed *five* of the plates through the melted tin, and from thence into the pot of tallow above-mentioned, a boy takes out one of them and puts it into the empty pot to cool, and the wash-man puts in the *sixth* plate. The boy then takes out a *second* plate, and lays it to cool likewise, when the man puts in his *seventh*, and so they go on, in this regular manner, until the whole of the parcel is finished.

In consequence of the plates being immersed in the melted tin in a vertical position, there is always, when they have become cold, a wire of tin on the lower edge of every plate which is necessary to be removed, and this is done in the following manner:

A boy, called the list-boy, takes the plates when they are cool enough to handle, and puts the lower edge of each, one by one, into the list-pot, which is the vessel that was before described as containing a very small quantity of melted tin, and the same as that which I have marked No. 5. When the wire of tin is melted by this last immersion, the boy takes out the plate, and gives it a smart blow with a thin stick, which disengages the wire of superfluous metal, and this falling off, leaves only a faint stripe in the place where it was attached. This mark may be discovered on every tin plate which is exposed for sale; the workmen, in the manufactory of them, call it the *list*.

Nothing now remains but to cleanse the plates from the tallow. This is done by means of bran, and as they are cleansed they are put into strong wooden boxes, or boxes of *sheet-iron*, made exactly to fit them; and this completes the whole business.

Art. XIV. *Miscellaneous Intelligence.*

I. Mechanical Science.

§ Astronomy, Navigation, Agriculture, &c.

1. *New Comets.*—M. Pons, of the Observatory at Marseilles, discovered on the 12th June, a comet in the constellation of Leo; it was very small, being invisible to the unassisted eye, and without any appearance of tail. M. Blanpain, was able to observe it on the 13th, 14th, 15th, 16th, and 19th of the same month; on the 13th at $11^h\ 13'\ 11''$ mean time, counted from

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mid-day at Marseilles, it had 152° 11′.6, of right ascension and 25° 22′.9 of northern declination on the 19th, at 10ʰ 6′ 10″, it had 154° 30′.5 of right ascension and 24° 4′.9 of northern declination.

M. Gambart has deduced the following parabolic elements from the observations of M. Blanpain.

Perihelium distance.....	0.88117	
Longitude of the Perihelium .....255.°	51′	
Longitude of the Nucleus .....107.°	46′	
Inclination of the Orbit	8.°	26′

Heliocentric Motion, direct.

M. Gambart has drawn as a conclusion from his calculations, that on the 24th July, this comet was removed from the earth, only one twentieth part of the distance of the earth from the sun.

Of the comet, which appeared so suddenly early in July, a mere notice cannot be necessary, as its brilliancy was sufficient to announce it to every one.

2. *Steam Boats in America.*—The following list of steam boats, now in operation on the River Mississippi, and its tributary streams, has been published by Mr. Robinson.

Vesuvius	Tons 390	Cincinnati .....Tons	120
Etna	390	Exchange	200
Buffalo	300	Louisiana	54
James Monroe.....	90	James Ross	320
Washington	400	Frankfort	320
Constitution	75	Tamerlane	320
Harnot	40	Cedar-Branch	250
Kentucky	80	Experiment	40
Governor Shelby	120	St. Louis	220
Madison	200	Vesta	100
Ohio	443	Rifleman	250
Napoleon	332	Alabama	200
Volcano	250	Rising States	150
General Jackson	200	General Pike	250
Eagle	70	Independence	300
Hecla	70	Paragon	400
Henderson	85	Maysville	150
Johnston	80		
			7,259

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There are now building the following Steam Boats.

	Tons.
2 at Pittsburgh of 180 tons	360
2 at Wheeling, of 500 and 100	600
2 at Steubinville	90
1 at Marietta	130
1 at Maysville	110
2 at Cincinnati	720
2 at Cincinnati 115 and 250	365
2 at Newport	500
1 at Jeffersonville	700
1 at Portland (Kentucky)	300
3 at New Albany each 220	660
4 at Clarksville	500
1 at Salt River	160
1 at Vevay	110
1 at Madison	120
1 at Rising Sun	90
1 on the Wabash	80
2 at New Orleans each 200	400
	5,995

It appears there have been lost by accidents of different kinds, the following steam-boats: Orleans, 400 tons; Comet, 15; Enterprise, 45; Dispatch, 25; Franklin, 125; Pike, 25; New Orleans, 300.

3. *Fly in Turnips.*—Lord Thanet, and Mr. Grey, both eminent agriculturists, have communicated to the Board of Agriculture their conviction from experiments, that lime sown by hand, or distributed by a machine, is an infallible protection to the turnip, against the ravages of the fly. It should be applied as soon as the turnips come up, and in the same daily rotation, in which they were sown; and the lime should be slaked immediately before it is used, unless the air is sufficiently moist to render that operation unnecessary.

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4. *On engrafting Trees.*—Trees are frequently grafted by making a transverse section of the bark of the stock, and a perpendicular slit beneath it; the bud is then pushed down to give it the position which it is to have; this operation is not always successful, it is better to employ an inverse method, *i. e.* to make the vertical slit above the transverse section, and to push the bud upwards into its position. This method rarely fails of success, because as the sap descends by the bark, as has been proved of late years, and does not ascend, the bud placed above the transverse section, receives abundance, whereas, if below, the sap cannot get to it. *Annales de Chimie*, xi. p. 110.

5. *Mildew in wheat prevented.*—"Salt one part, water eight parts. With this mixture sprinkle the diseased corn. Where the corn is sown in drills, this may be done with a watering-pot, but the best and most expeditious mode is with a flat brush, such as white-washers use, having a tin collar made water-tight round the bottom, to prevent the mixture dropping down the operator's arm, and running to waste. The operator having a pail of salt and water in one hand, and dipping the brush into the mixture with the other, makes his regular casts, as when sowing corn broad cast; in this way he will readily get over ten acres in the day. About two hogsheads will do one acre: wherever the mixture touches, in three or four days the mildew will disappear; upon those parts that escape, the sprinkling must be repeated. If judiciously cast, the mixture falls in drops as uniformly as rain."

II. Chemical Science.

§ Chemistry.

1. *On Oxygenated Water, by M. Thenard.*—M. Thenard, in his further researches on oxygenated water and its properties, has ascertained that the remarkable effects produced, when it is placed in contact with platinum, gold, silver, *&c.*, are occasioned also by the contact of several animal substances; and that all

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the oxygen is disengaged without any immediate action on the substance, at least when the oxygenated water is diluted.

Pure oxygenated water was diluted until it contained only eight times its volume of oxygen, and twenty-two measures of it introduced into a tube filled up with mercury. A small quantity of perfectly clear and white fibrine, recently obtained from blood, was introduced, and immediately the oxygen began to separate. In six minutes the water was perfectly de-oxygenated, and gave no effervescence with oxide of silver. The gas then measured 176 parts; it contained neither carbonic acid nor nitrogen, but was pure oxygen. The same fibrine, placed many times in contact with fresh oxygenated water, still acted in the same way.

Urea, albumen, fluid or solid, and gelatine, did not separate oxygen from water much oxygenated; but a portion of the lungs cut in thin pieces and well washed, or of the kidney, or the spleen, disengaged the oxygen as readily as the fibrine. The skin and the substance of veins also possess this property, but in an inferior degree.

"But since fibrine, the lungs, the kidney, the spleen, &c., possess, like platinum, gold, and silver, the property of disengaging the oxygen from oxygenated water, it is very probable that all these effects are caused by the same power. Is it unreasonable to suppose, also, that it is by an analogous power that animal and vegetable secretions are caused? I do not think it is; one may conceive in this way how an organ, without either absorbing or giving off any thing, may constantly act on a liquid, and convert it into new products. This mode of viewing the subject accords well with some ideas which have been urged lately, and which are rendered, as it were, palpable by the experiment described in this note." *Annales de Chim.* XI. p. 85.

850, given in the former observations on oxygenated water, as the number of volumes of oxygen which water could be made to take up, appears to be an error in printing; it should have been 616. (See page 379, Vol. VII.)

2. *Delphine, a New Vegetable Alkali*—Described by MM. Lassaigne and Feneulle in a letter to M. Gay-Lussac.

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Whilst engaged in analysing the seed of this vegetable (*Delphinium Staphysagria* of Linnæus,) we obtained a white crystalline substance, of an extremely acrimonious taste, becoming afterwards bitter. This substance possesses alkaline properties; it renders syrup of violets green; it restores the blue colour of litmus, reddened by acid; it acts with acids like morphia, strychnine, and picrotoxine, with which it ought to be classed. The principal characters we have ascertained belonging to this substance are the following: It is a fine white powder, inodorous, and, when viewed in the sun-light, having a bright appearance. Thrown on burning coals, it fuses and burns with a white thick smoke of a particular odour, and leaves no residuum. It is slightly soluble in water, but alcohol and sulphuric ether dissolve it with facility.

It forms very soluble salts with sulphuric, nitric, hydro-chloric, and acetic acids; their taste is bitter and acrid. Potash, soda, and ammonia, precipitate it in flocculi, which, collected in a filter, appear like gelatinous alumine.

According to our experiments, this alkaline substance exists in the seeds of the stavesacre, combined with the malic acid. To this combination is owing the acrid taste of the seeds of this ranunculus, and which exists only in the cotyledons.

The process we followed in extracting this substance is the same with that proposed by M. Robiquet for morphium. We boiled a portion of the cotyledons that had been treated with ether, in a little distilled water; the filtered fluid was mixed with a little pure calcined magnesia, boiled for a short time, and filtered; the residuum, washed carefully, was subjected to the action of boiling alcohol of 40° (sp. gr. 817.) This alcohol evaporated spontaneously, left the new substance in the capsule with the characters we have already described. We also succeeded by two other means in obtaining it of great purity.

If, as we believe, this alkaline body differs from those before named, we propose to call it *Delphine*, a name which will call to mind, as with *strychnine*, the name of the genus to which the plant belongs from which it is extracted.

We will shortly make known, in a more detailed paper, the

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history of this alkaline substance, and the method we have adopted in analyzing the stavesacre."

Paris, July 12, 1819. *Annales de Chim.* XI. 188.

3. *On the action of Nitric Acid, Chlorine, and Iodine, on Uric Acid, by* M. Vauquelin.—For eight months I have employed all my leisure moments in those researches on the action of nitric acid, chlorine, and iodine, on uric acid, announced by M. Brugnatelli, and repeated by Dr. Prout. To detail here all the experiments I have made on this subject would be too tiresome, but I shall give the principal results of them. I have not been able to gather any thing useful from the memoirs of Messrs. Brugnatelli and Prout; because, one of these gentlemen has not given the process which he followed for the preparation of what he calls purpuric acid, and what the other has said appears unintelligible to me, and because these chemists contradict each other on a great number of points, respecting the properties of the acid they have discovered.

I will first observe that uric acid suffers the same changes, and gives the same products, whether it be treated with nitric acid, chlorine, or iodine; but these products change in their nature according as the action of the agents is continued to a lesser or greater extent. If this action is retarded, a large quantity of a particular colouring matter is formed, and very little acid; if it is carried farther, without passing certain limits, little colouring matter is obtained, but a much larger quantity of acid; and finally, if the action be continued for a long time, these two substances disappear, and oxalic acid and ammonia only are obtained. Thus in varying the quantity of these bodies, and the manner in which they act on the calculous matter, we may obtain at pleasure various products, and in proportions very different.

The best proportions to produce the colouring matter, are 100 parts of nitric acid, at 34° (S. G. 1.307?), mixed with 100 parts of water, and 50 parts of uric acid, at a low heat. The solution obtained has a fine scarlet colour. If fresh quantities of nitric acid be added to it, and boiled, the red colour

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disappears, and a yellow one succeeds. If into the first solution, milk of lime, very finely mixed, be introduced, the lime dissolves, but on approaching the point of saturation, a red crystalline and brilliant substance is deposited. The same milk of lime, put into the second solution, or that to which nitric acid has been added, produces the deposition of a white or pale yellow substance, also crystallized, and of a brilliant appearance. This last substance is a combination of the lime with the new acid, formed by the action of the nitric on the uric acid. The first is a similar combination, containing a certain quantity of colouring matter, formed also at the expense of the uric acid.

After purifying this salt by repeated crystallizations, I decomposed it by a sufficient quantity of oxalic acid, and obtained the new acid in its pure state. It is white, fusible, of an acid taste, readily soluble in water and alcohol, saturating but small quantities of bases, and giving, when decomposed by heat, hydrocyanate and carbonate of ammonia, empyreumatic oil, and charcoal. It causes white precipitates with the acetate of lead, muriate of tin, and nitrate of mercury; but it does not precipitate nitrate of silver, nor does its saline combination affect that test. Dissolved in nitric acid, and evaporated to dryness, it does not produce a red colour.

The combination of the calculous acid with lime does not precipitate solution of silver, but the same combination united to colouring matter precipitates the salt of silver of a fine purple colour. I took advantage of this property to separate the colouring matter from the acid, I mixed a coloured solution with nitrate of silver, until no further precipitate was formed; it was of the finest purple, and as soon as it had fallen, and the fluid become clear, they were separated, and the deposit washed several times; being afterwards mixed with a small quantity of water, it was decomposed by the necessary quantity of hydro-chloric acid. The colouring matter thus precipitated by the silver, the acid to which it was united was found in the fluid; for, on adding to it a little lime, a white precipitate was formed, being the combination with silver.

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The chloride of silver being separated, I obtained a fine red fluid, in which there was neither silver nor hydro-chloric acid. The following are the properties of this colouring matter; it is neither acid nor alkaline; acids destroy its colour, making it yellow, and nothing can restore its first tint. If only a small quantity of acid is added, the colour passes to scarlet before it disappears. The alkalies, and the oxides of lead, silver, and copper, convert it to a violet colour, but do not destroy it. Lime does not act strongly on its colour; its combination with it preserves the red tint. It adheres to metallic oxides, neutral salts, and to animal and vegetable substances; but it cannot long resist the action of air and the sun, which change it to yellow.

It follows from what I have detailed, that by the action of nitric acid, chlorine, and iodine, on uric acid, there is formed a peculiar acid, which is without colour, and an azotated colouring matter, which is not acid, but which has a stronger analogy to the bodies of this class than to the alkalies. It is this colouring matter, which, mixed with the peculiar acid of the calculus, has made Messrs. Brugnatelli and Prout believe the acid itself was coloured, and has caused one to give it the name of erythric acid, and the other purpuric acid; names, which we may observe, are not applicable to it.

I have made a great number of experiments on this acid, and its combinations with different bodies; I have also submitted the colouring matter to many tests, of which some have given me curious results. I have carefully examined the manner in which nitric acid, chlorine, and iodine, act on uric acid, and the various bodies which, according to circumstances, result. That which required the most time was a search after some simple and exact method of separating the acid and colouring matter from each other. I shall shortly publish these experiments, with the necessary details.

As names are required for these two substances, I shall propose, for the present, for the acid, the name of *peroxygenated uric acid**, and for the colouring matter, that of *erythrine*.

* Better oxy-uric acid.

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4. *Persian Metallurgical Processes.*—The following metallurgical operations were described in the laboratory of the Royal Institution, by Oostad Muhammed Ali. From the clear manner in which he illustrated the description, by the disposal of the apparatus about him, there is not much chance of any important error or omission in this account of them.

Persian Method of purifying Silver.—A sort of basin is made, either by excavating the ground, or by arranging stones in a circle. This is from nine to twelve, or fourteen inches wide, and is incomplete at the side in one place, for the reception of the fuel, which, by its combustion, is to melt the metal. The fuel consists of two large and long logs of wood, which are placed with their ends in the aperture on the edge of the basin. These ends are lighted by putting a little burning fuel on them, and then the blast from a pair of bellows is directed on to and over the fire, so as to direct the flame and heat into the basin, in the manner, indeed, of a large blow-pipe. Lead, containing silver, or impure silver with lead, is then placed in the basin, which being soon melted and heated by the flame, is purified as by common cupellation. The litharge is forced off to the sides as it is formed, and either absorbed or lost, and as the wood burns away before the jet of air, the logs are thrust onwards, until all is consumed; then fresh logs are applied, if necessary, or the process is stopped, as may be found expedient.

Manufacture of Steel in Persia.—Oostad Muhammed Ali thus describes Persian steel-making:—Iron is brought from the mountains, but he does not know how it is obtained: a square place is built up, about four feet in the side, and five or six feet high, the walls being eight or nine inches thick; stones of a slaty kind are put across this on the inside, about eighteen inches from the bottom, so as to form a grate; below this is a chamber for the reception of the melted steel, and above it is placed the iron in bars, and charcoal intermingled together. There are three apertures just above the grate into the furnace, into which air is propelled from bellows, worked by men sitting; a fire is lighted, and the heat raised, fresh charcoal is thrown on as that in the furnace burns away; and as the iron becomes

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carbonized, it melts and falls through the grate as fluid cast steel, into the chamber beneath, from whence it is taken and cast into ingots.

From three to four hundred weight of iron is placed in such a furnace, and there is a loss of about one-third from oxidation, and adhesion to the sides: The operation requires from two to three days, with constant blowing. M. Muhammed described the charcoal as being exceedingly hard and heavy, and very unlike our charcoal, but did not know of what wood it was made.

5. *Process for obtaining pure Nickel.*—The following is a process recommended by Dr. Thomson, for procuring pure nickel:—" I take a quantity of the brittle reddish alloy, well known in commerce by the name of *speiss*. This alloy is chiefly an arseniuret of nickel, though it probably contains also, occasionally at least, several other metals. Upon the speiss reduced to a coarse powder, I pour a quantity of dilute sulphuric acid, place the mixture in a Wedgewood evaporating dish upon a sand bath, and add the requisite quantity of nitric acid at intervals, to enable the acid to act upon the speiss. By this process I obtain a deep grass-green liquid, while a considerable quantity of arsenious acid remains undissolved. The green liquid, carefully decanted off the arsenious acid, is evaporated on the sand bath, till it is sufficiently concentrated to yield crystals. It is then set aside in a cool place. A deposit of beautiful crystals of sulphate of nickel is obtained. By concentrating the liquid still further, more crystals of sulphate of nickel fall, but after a certain time the liquid, though its colour continues still a dark green, refuses to yield any more crystals of sulphate of nickel. By evaporating it to the required consistency, and then setting it aside, a very abundant deposit is made of an apple-green salt, which adheres very firmly to the evaporating dish. I took this matter at first, from its colour, to be arseniate of nickel; but I found it, on examination, to be a double salt, consisting of sulphate of nickel and arseniate of nickel, united together. I endeavoured to get rid of the

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arsenic acid by dissolving the salt in water, and causing a current of sulphuretted hydrogen gas to pass through it, as long as any precipitate appeared. By this method I threw down a great deal of arsenic, but on filtering and evaporating the liquor, it was still converted into an apple-green matter, and, of course, contained arsenic. I found that when the salt was dissolved in water, the liquid became opaque, owing to a quantity of arsenious acid, which separated from the salt. The liquid being now filtered, to get rid of the arsenious acid, and properly evaporated, yielded a new crop of crystals of sulphate of nickel. These crystals continued to be deposited as long as a single drop of the liquid remained unevaporated. By this method may the whole of the nickel in the speiss be obtained in the state of sulphate of nickel. This sulphate is quite free from arsenic or arsenious acids, for the presence of these acids prevents sulphate of nickel from crystallizing. But for greater security I dissolve the sulphate of nickel in water, and crystallize a second time.

The pure sulphate of nickel thus obtained, is dissolved in water, and decomposed by carbonate of soda. The carbonate of nickel, when well washed and dried, is a light-green powder. I make it up into balls with a little oil, enclose these balls in a charcoal crucible, which is put into a Hessian crucible, the mouth of which is covered and luted. It is now exposed to the greatest heat that I can raise, in a melting furnace for two hours. By this process I have always obtained a button of pure nickel in the metallic state.

The nickel thus obtained is hard, but malleable, and very obedient to the magnet. I think it contains a certain proportion of carbon in combination with the nickel. The button is usually surrounded with a thin dark shining cuticle, which I take to be a carburet of nickel.—*Annals of Philosophy.*

6. *Analyses of Coal.*—Dr. Thomson, has lately analysed the varieties of pit-coal, with very extraordinary results.—The species examined were, 1. caking coal, or Newcastle coal; 2. splint coal, or light burn hard coal, being the fifth of the six

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Glasgow coal-beds, or the lowest of those now wrought. This coal is the only kind employed at Glasgow, for making coke, and it is also solely used for the smelting of iron. 3. Cherry coal or soft coal; this kind constitutes the greatest part of the four uppermost of the Glasgow beds, especially the third and fourth beds. The Staffordshire coal, too, appears to be of the same kind. 4. Cannel coal.

The earthy part was ascertained by burning a certain portion of each coal; the other elements were ascertained by the products given, when a portion of the coal was heated with the peroxide of copper. The results are that caking coal is composed of

33 atoms carbon.....	24.75.....	75.28
11 .....hydrogen...	1.375	4.18
3 .....azote	*5.25	15.96
1.5 ....oxygen	1.5	4.58 †
	32.875	100.

So that the weight of an integrant particle of caking coal cannot be less than 32.875, and it must be either that number, or a multiple of it.

Splint coal contains,

28 atoms carbon.....	21.	75.
14 ..... hydrogen ..	1.75	6.25
1 ..... azote	1.75	6.25
3½ .... oxygen	3.5	12.5.
	28.	100.

Cherry Coal gave,

34 atoms carbon.....	25.5	74.45
34 ..... hydrogen ..	4.25	12.4
2 ..... azote	3.5	10.22
1 ..... oxygen	1.	2.93
	34.25	100.00

* Erroneously printed in the annals, 2.25.

† Erroneously printed in the annals, 9.58.

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Cannel Coal gave,

11 atoms carbon	8.25	64.72
22 .....hydrogen ..	2.75	21.56
1 .....azote.....	1.75	13.72
	12.75	100.

The singular relation observed between the carbon and the hydrogen surpasses all expectation. It is perhaps the first instance offered to us, where these general elements of animal and vegetable substances, combined in such different proportions, give such similar substances as the four varieties of pit coal; and what increases the wonder is, that Dr. Thomson seems inclined to think that coal is a direct combination of these elements, and not any compound of bitumen, &c., as has been supposed.

7. *Analysis of the Water of the Dead Sea, by* M. Gay-Lussac.—The water had been preserved in a vessel of tinned iron, hermetically closed. When poured out it had no bad or bituminous smell: it was slightly turbid, but soon became perfectly clear, M. Bose could not discover any microscopical animals in it. Its taste was very saline and bitter.

Its specific gravity at 17° (62°. 6 Fahr.) was 1.2283. This is sufficient to enable a man to float on the surface of the Dead Sea without motion; but it contradicts the statement of Strabo, who says, that a man may remain upright in it, without sinking below the navel. At present 81 hundredths of his volume would be submerged, and it is not probable that the Dead Sea was more saline formerly than at present.

The water, exposed to a temperature of 7° below freezing (19°.4 Fahr.) did not deposit any salt; so that it is not saturated: it however deposited muriate of soda, at the temperature of 15° (59° Fahr.) when it had lost 4.71 hundredths of its weight.

Saussure's hygrometer, placed in the air in contact with this water, indicated about 82°; so that the air contained only two-thirds of the moisture it would have taken up, if it had stood

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over pure water. From this it results, that the air will not carry off water from the Dead Sea, except when below 82° of humidity, and that it will give water to it, when it is above that point. The borders of the Dead Sea should, therefore, constantly enjoy a dry atmosphere. It is very probable that that sea has arrived at a fixed degree of saltness, relative to the humidity of the air and its temperature; a conjecture which could be verified if the mean hygrometrical degree at its surface were known.

100 parts of the water gave, by evaporation, a saline residuum, which, when dried perfectly, account being taken of the muriatic acid which the heat disengaged, weighed 26.24. This residuum was composed of

Chloride of sodium, (common salt).....	6.95
Chloride of calcium (muriate of lime)	3.98
Chloride of magnesium (muriate of magnesia)	15.31
	26.24

It contained also, a small quantity of chloride of potassium, (muriate of potash) and traces of a sulphate, probably with a base of lime.

From an examination of the water of the River Jordan, it was found to contain principally common salt, with some muriate of magnesia, a very slight quantity of sulphate of lime, and, probably, also muriate of lime, but in very minute quantity. This salt did not appear to be in the same proportion as in the water of the Dead Sea. The sulphate of lime, for instance, is relatively in more abundance in the first; but it is probable that the large quantity of muriate contained in the latter, prevents the sulphate of lime from remaining in solution.

Annales de Chimie. xi. p. 195.

8. *Chesnut Wood substituted for Oak-bark.*—There is an account given by Mr. W. Sheldon, in Professor Silliman's *Journal*, of the chesnut-tree, and the application of its wood to the purposes of tanning and dyeing. By analysis it has been found that chesnut *wood* contains twice as much tanning as cleaned

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oak-bark, and six-sevenths as much colouring matter as log-wood. Leather tanned with it is described as superior to that tanned with oak-bark. Ink made with it is admirable, and in dyeing it seems to have a greater affinity for wool than either galls or sumach, causing, therefore, a more permanent colour.

The inspissated aqueous extract of the chesnut wood very much resembles catechu; except that, according to Professor Dewey, of William's College, it precipitates a fourth more of gelatine; and in dyeing it is infinitely superior, for it gives the finest black, whilst the colour obtained from catechu is only a meagre olive.

Mr. Sheldon concludes his letter by some details and observations, which will perhaps induce many to receive the more important part of it with caution. On making solutions of the wood, one from the trunk of a tree three feet thick, and another from a limb about three inches in diameter, and precipitating them by the same quantity of solution of gelatine, the precipitates appeared in congeries, bearing a proportion in size to the sticks from which they were obtained. Mr. Sheldon thinks this may lead to a new nomenclature of precipitates, and to the illustration of the compound nature of bodies, and of chemical, or electro-chemical, affinities; and further, that even the *size* of a stick may probably be ascertained with almost as much precision as by *actual admeasurement*.

The editor of Silliman's *Journal* states having verified the most important of Mr. Sheldon's experiments.

9. *Maple Sugar.*—Experiments were made some years since in France, for extracting sugar from the maple-tree, but they were subsequently abandoned. It appears, however, that in Bohemia better success has been obtained, and that M. Bodard has received important information on the subject. An incision was made in a maple-tree, from which a quantity of syrup issued, which afterwards produced sugar, rivalling, as it is said, that of the beet-root, or the cane.

10. *Preservation of Water at Sea.*—M. Perinet, after an exa-

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mination of the means which are, or may be, adopted for the preservation of fresh water at sea, gives the preference to the following: 1½ parts of oxide of manganese in powder is mixed with 250 parts of water, and agitated every 15 days. In this way water has been preserved unchanged for seven years.

The editor of the *Annales de Chimie* observes, that oxide of manganese has the power, not only of preserving water, but of rendering that sweet which has become putrid; but he also points out the important circumstance, that the oxide is slightly soluble in water, and therefore recommends the use of iron tanks for the water, as in England.

11. *Analysis of Sea Water.*—According to an analysis of sea-water from the Coromandel coast, made by M. Plagne, professor of chemistry, &c., it would appear to contain the following proportions of substances.

Carbonic acid	0.000033
Muriate of magnesia	0.009280
Muriate of soda	0.023100
Sulphate of lime	0.001064
Sulphate of magnesia	0.001524
Sub. carb. of magnesia	0.000140
Sub. carb. of lime	0.000060
Animal mucus	0.000080
	0.035281

M. Plagne searched diligently for nitrate of potash, but was not able by any means to detect its presence.

12. *Titanium in Iron Ores.*—M. Robiquet has lately examined the oxidulated octoedral iron, from the steatite of Corsica, and has found it to contain a considerable portion of titanium. It dissolved completely in muriatic acid, but the solution, evaporated to dryness at a moderate heat, and re-dissolved in water, left a white pulverulent substance, which, when fused with potash, and afterwards dissolved in muriatic acid, gave all the characters of a solution of titanium. In this way, six parts have been separated from 100 of the mineral. M. Robiquet is in-

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duced to suppose, therefore, that titanium generally accompanies the oxidulated iron in nature, and that this compound is not peculiar, as has been supposed, to volcanic countries.

Berzelius found titanium in the iron ore of the Isle of Elba.

13. *Chemical Prize Subjects.*—The following subjects have been proposed by the Royal Academy of Copenhagen: 1. Num principium illud Scytodepsicum, quod ope caloris in materiis vegetabilibus formatur ejusdem est naturæ ac illud, quod ex galla, ex cortice quercûs, etc., extrahitur, an ab hoc discrepat? An et quatenus in arte coriarâ adhibiri potest? Et quæ sunt conditiones, quibus satisfieri debet, ut maximâ quantitate producantur?

2. Mutationes chemicas, quæ in fœno eveniunt, dum inter fermentationem colorem badium contrahit, accurate examinare; nec non investigare, anne ex notitiis rei chemicis indi comparatis utiles quædam regulæ de confectione et usu talis fœni deduci possint?

The prizes attached to these subjects are each of 100 rubles. The papers may be written in Latin, English, French, German, Swedish, or Danish, and are to be sent to M. H. C. Orsted, secretary to the Academy, by the month of December of this year.

14. *Strength of Ætna Wines.*—The following wines were furnished to me by Mr. Ridgway. The specific gravity of the alcohol, of which the proportions per cent. are given beneath, is, 825 at 60° F.

Ætna red contained	18.9	per cent.
Ætna white.....	18.16	ditto
Ætna Sercial	19.	ditto
Ætna white Falernian.....	18.99	ditto
Ætna red Falernian	20.	ditto.

M. F.

15. *On the Oxidation of Silver and Copper.*—In a letter from S. Lucas, Esq. to Mr. Dalton.

Sheffield, May 31, 1815.

Dear Sir,—When I had the pleasure of seeing you in Man-

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chester, I mentioned having observed that pure silver, when melted, and while in a fluid state, had the property of uniting with a small proportion of oxygen, not only from the atmosphere, but also from other bodies which gave it out at a suitable degree of heat, as some of the nitrates for instance; and that the oxygen thus absorbed remains united with the silver only so long as it continues in a fluid state, or while fluid, until some substance be applied, having a more powerful attraction for the oxygen. In proof of this, I now send, for your inspection, a few specimens of silver that has been in the different states, and which carry the external marks: and also a bottle of the gas collected from silver, which had been exposed to the influence of the atmosphere by cupellation.

If silver in large quantities, after having been exposed in a melted state to a current of oxygen gas or atmospheric air, be allowed gradually to cool, the surface first becomes fixed or solid; this soon bursts, ebullition ensues, and an elastic vapour in considerable quantity escapes, driving before it a portion of the internal fluid metal, which, becoming solid as it is brought to the surface, produces the protuberances as shewn by the accompanying specimen, No. 1. This ebullition continues from $\frac{1}{4}$ to $\frac{1}{2}$ an hour or more, according to the quantity of silver, and the rapidity with which it is cooled.

If, instead of cooling gradually, it be made to assume the solid state suddenly by pouring it into water, still the same phenomena occur; an ebullition takes place, and oxygen gas is evolved, but as the silver is so much divided, and passes so suddenly from the fluid to a solid state, the protuberances are proportionably minute, and are spread more equally over the whole surface, as will be seen in specimen No. 2.

No. 3 shews the arrangement of crystallization, which the silver assumes when the gas is separated from it, during the time of its becoming solid.

I have before observed, that substances having a powerful affinity for oxygen, will take it from the silver, even while in a fluid state. Thus, if charcoal be spread, for a few moments only, on the surface of silver that has absorbed oxygen, the whole

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of the oxygen will immediately be taken from it; no ebullition or escape of gas occurs, whether it be cooled gradually, as in specimen No. 4, or when poured into water, as in No. 5. By comparing these two specimens with Nos. 1 and 2, a very great difference will be observed, which is occasioned wholly by the escape of gas from the latter, while no such circumstance attended the former.

The bottle of gas which you will receive herewith, was collected in the following manner. Some silver, after cupellation, till in a state of perfect purity, was poured, by a few pounds at a time, into a vessel containing about 30 gallons of water, and an inverted bottle previously filled with the water, and with a funnel in its mouth, being instantly placed over the silver, as it was each time poured into the water, the gas, as it was given out and arose from the silver, was thus collected in the bottle until it was filled.

Care is necessary, that the neck of the bottle be kept below the surface of the water to prevent the access of atmospheric air, and I am not very certain that there is not a little admixture *.

In addition to the above, I have enclosed two samples of copper, in two different states, both, however, equally pure, except that the one is believed to be combined with oxygen, and the other not.

No. 1, is a sample taken from a furnace-full of about 5 cwt., when in a melted state, and which had been exposed uncovered to a current of atmospheric air for about two hours before and during the time it was melting. This, when poured into water exploded most violently, as will be seen by the small, which was attempted to be granulated.

The specimen No. 2, is a sample from the same copper, after the surface had been covered with charcoal for about half an hour. This, you will perceive, is in a very different state from the other, and, when poured into water, granulated without any explosion, as the small bits will shew. I remain, &c.

(Manchester Transactions.) SAMUEL LUCAS.

* I found this gas to contain 86 or 87 per cent. of oxygen. J. D.

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§ 2. Mineralogy, Geology, &c.

1. *Native Carbonate of Magnesia.*—This substance has lately been discovered at Hoboken, in Staten Island, at the same place where the hydrate of magnesia was found by Dr. Bruce. It occurs in horizontal veins about two inches thick, in a serpentine rock. At first it was soft, white, and slightly adhesive; but when dry it easily rubbed to powder. It is perfectly soluble with effervescence in sulphuric acid, yielding, on evaporation, crystals of sulphate of magnesia. More lately, the same gentleman has discovered in the same place, veins of carbonate of magnesia, in fine acicular crystals. They were grouped in minute fibres, radiating from the sides; sometimes the crystals were suspended, and assumed the stalactitic form.

2. *Analysis of the Euclase, by* M. Berzelius.—I owe to the generosity of M. de Souza, formerly ambassador from Portugal to France, the specimen of this rare stone, which I have employed for an analytical experiment. The stone reduced to powder was heated with carbonate of soda, in a platinum crucible, and then being acted on by dilute muriatic acid, left a light white powder, which was separated; the fluid was evaporated to dryness, and treated as is usual in analyses of the emerald. The powder, insoluble in muriatic acid, resembled oxide of tantalium. It was heated with super-sulphate of soda; a portion dissolved, but as the whole of the saline mass was soluble in water, the powder could not be oxide of tantalium. A current of sulphuretted hydrogen gas was passed into the solution, and threw down a yellowish precipitate, which, after being dried and weighed, was entirely reduced before the blow-pipe, and gave a globule of tin. The fluid, precipitated by the gas, gave, with ammonia, a precipitate soluble in carbonate of ammonia. It was glucine. I have thought it right to notice this property which glucine has of giving, with oxide of tin, a combination which resists for a long time the action of acids, because, in the analysis of the gadolinite of Kovarfurt, the same thing happened to me with a combination between glucine and the oxides of manganese and ce-

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rium. These combinations are frequently formed, even by the analytical processes, and embarrass the operation. I have found, nevertheless, that, by means of the long-continued action of concentrated muriatic acid, it is dissolved. I obtained from the euclase,

Silex	43.22
Alumine	30.55
Glucine	21.78
Oxide of iron	2.22
Oxide of tin	.7
	98.47

M. Berzelius afterward, by comparing the quantity of oxygen in the earths, found them to be in the glucine, alumine, and silex, nearly as 1, 2, and 3; and then, according to the laws which he assumes to be established, conceives the correct composition of the euclase to be as follows:

Silex	44.33
Alumine	31.83
Glucine	23.84
	100.00

Thus represented, GS + 2 AS.

3. *Skeleton of a Whale.*—On Monday, August 19th, while some workmen were employed in making improvements upon the estate of Airthry, the property of Sir Robert Abercromby, Bart., about 300 yards south from the east porter's lodge, which leads to Airthry-castle, they came upon a hard substance, which proved to be the skeleton of a large-sized whale, dimensions nearly as follows:

	Ft.	In.
Head, or crown-bone, in breadth	8	5
——— length	5	0
There are nine vertebræ, some of which are in diameter, independent of the processes	1	8
——— breadth, with the processes	3	6
Two bones of the swimming paws, 1 of them in length	5	4

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	Ft.	In.
The other (broken)	3	8
Circumference of these bones	3	8
Six broken pieces of bone, from 1 to 4 feet in length.		
Thirteen ribs, one is in length	10	0
—— in circumference	1	1
Another in length	9	3
Ditto in circumference	1	2

A very entire, oval, and hollow bone, like a shell, was found, also, 5 inches long, and 3 in diameter; and along with the bones a fragment of the lower part of a stag's horn was found, 14 inches long, and 8 in circumference.

All these bones occurred at a depth of from 18 inches to 3 feet from the surface of the ground, in what is termed recent alluvial earth, formed by the river Forth, and composed of a blue coloured sludge or sleek, with a covering of peat earth, a few inches thick.

The situation where the bones were dug up naturally refers to a very remote period of time, of which we have no record, when the river Forth was here a great arm of the sea, extending from the Ochill Mountains, on the north, to the rising ground in the Falkirk district, on the south; and when the very interesting and picturesque greenstone rocks of Abbey Craig, Stirling Castle, and Craigforth, formed islands in the midst of the water. According to the situation of the Roman stations and causeways at a small distance from whence the skeleton has been found, it may reasonably be concluded that the whale had been stranded at a period prior to the Christian æra.

Tilloch. Magaz. Aug. 157.

III. Natural History.

§ 1. Botany, Zoology, &c.

1. *Latitude of Trees in Sweden.*—From researches made in Sweden on the different kinds of wood indigenous to the country, it has been ascertained that the birch reaches the

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farthest north, growing beyond the 70th degree; the pine reaches to the 69th; the fir-tree to the 68th; the osier, willow, aspien, and quince, to the 66th; the cherry and apple-tree to the 63d; the oak to the 60th; and the beach to the 57th; while the lime-tree, ash, elm, poplar, and walnut, are only to be found in Scania.

2. *Simultaneous existence of Salt and Fresh Water Mollusca, in the Gulf of Livonia.*—The difficulty experienced in Geology, of explaining the simultaneous existence in certain strata of salt and fresh water shells, and also the importance, perhaps exaggerated, which many persons have attached to this discovery, induced M. Beudant, some years since, to undertake experiments, with the view of ascertaining if it were possible to habituate marine shell mollusca to live in fresh water, and, *vice versâ*, fresh water shell mollusca to live in salt water. It appeared from the results obtained, that these changes could really take place, but the mixture of these two sorts of animals in the same water had not been observed in nature. M. de Freminville, lieutenant of a vessel, a zealous cultivator of the sciences of Zoology and Geology, has announced, in a letter to M. Brongniart, dated February 11, 1819, this curious discovery.—" The lesser degree of saltness of the waters of the Baltic Sea is more sensible in the Gulf of Livonia than any where else. It is such that the fresh water mollusca live there very well; and I have found on the shores of Unios, Cyclades, and Anodontes, living intermingled with carduums, tellenes, and Venus's, shell fish which generally live in the most salt waters."—*Journal de Physique, July* 17, 1812.

3. *Singular Anecdote of the Spider, with Observations on the Utility of Ants in destroying Venomous Insects.* By Captain Bagnold.

Desirous of ascertaining the natural food of the scorpion, I enclosed one (which measured three quarters of an inch from the head to the insertion of the tail) in a wide-mouthed phial, together with one of those large spiders, so common in the West

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Indies, and closed it with a cork, perforated by a quill, for the admission ofair; the insects seemed carefully to avoid each other, retiring to opposite ends of the bottle, which was placed horizontally. By giving it a gradual inclination, the scorpion was forced into contact with the spider, when a sharp encounter took place, the latter receiving repeated stings from his venomous adversary, apparently without the least injury, and, with his web, soon lashed the scorpion's tail to his back, subsequently securing his legs and claws with the same materials. In this state I left them some time, in order to observe what effect would be produced on the spider by the wounds he had received. On my return, however, I was disappointed, the ants having entered and destroyed them both.

In the West Indies I have daily witnessed crowds of these little insects destroying the spider or cockroach; as soon as he is despatched, they carry him to their nest. I have frequently seen them drag their prey perpendicularly up the wall, and although the weight would overcome their united efforts, and fall to the ground, perhaps twenty times in succession, yet, by unremitting perseverance, and the aid of reinforcement, they always succeeded.

A struggle of this description once amused the officers of His Majesty's ship Retribution for nearly half an hour: a large centipede entered the gun-room, surrounded by an immense concourse of ants; the deck for four or five feet around was covered with them, his body and limbs were encrusted with his lilliputian enemies, and although thousands were destroyed by his exertions to escape, they ultimately carried him in triumph to their dwelling.

In the woods near Sierra Leone I have several times seen the entire skeletons of the snake beautifully dissected by these minute anatomists.

From these circumstances it would appear, that ants are a considerable check to the increase of those venomous reptiles, so troublesome in the torrid zone; their industry, perseverance, courage, and numerical force, seem to strengthen the conjec-

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ture; in that case they amply remunerate us for their own depredations.

§ 2. METEOROLOGY, ELECTRICITY, &c.

1. *Meteorolite.*—The following description of a previously unrecorded meteorolite is from the *Journal de Physique* for April. It is given from M. Cavoleau in a letter to M. Dubuisson.

" On the 5th of August, 1812, at two o'clock in the morning, whilst the weather was calm and the sky clear, a meteor, dazzling with light, struck the sight of some travellers and countrymen in the neighbourhood of Chantonnay, in the department of La Vendée, on the road from Nantes to La Rochelle. It was said to have been seen at many leagues' distance. The time of its duration was not observed, but it terminated in a violent explosion, which was compared to the loudest clap of thunder which had been heard in that country.

In the middle of the day the master of the farm of la Haute Revétison, 4,000 metres (4374,5 yards) from Chantonnay, perceived, in a field near to his house, a large stone, which he had never before observed. It was buried two feet and a half in the earth, and had a strong smell of sulphur, which it retained during six months, but which at last was lost."

At the end of December, 1814, M. Cavoleau became acquainted with this fact, and judging from this relation and the appearances of the stone, that it was an aërolite, he sent an account of it, with some fragments, to M. Dubuisson, who says—" 1. The crust, or envelope, appears to me to differ from that of other falling stones of this kind, in passing from a black colour to the yellow of peroxide of iron. 2. It differs also from other pieces of this kind in the internal parts, giving sparks when struck by steel, though not so abundantly as the outside. 3. The internal part, like the crust, scratches glass. 4. The form of the mass appears to have been rounded, and to have had many cells and cavities. The interior is granular, of an earthy appearance, with the exception of some brilliant

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points of meteoric iron, which are abundant, and some of the sulphuret of iron, rather rare. Its colour is variable, it passes from the common grey to the yellow of oxide of iron, and afterwards to a blackish brown." M. Dubuisson concludes by expressing his conviction of its being a meteoric stone.

2. *Prize Question in Meteorology.*—The Academy of Sciences, Arts, and Belles Lettres, at Dijon, proposes the following question as the subject for a Prize, in 1821:—"How far is it possible, in the present state of natural philosophy, to explain aqueous meteorological phenomena?"

3. *Earthquake.*—It is mentioned in accounts from Rome, that a violent shock of an earthquake was felt at Corneto, on the 26th of May, which considerably damaged several edifices, but no lives were lost. The celebrated cupola of Castello, remarkable for its antiquity and its Gothic architecture, was thrown down; and the church of the minor friars, of which it formed a part, was so much damaged as to prevent the performance of service in it. The shock is stated to have been felt along the whole coast of the Mediterranean.

4. *New Voltaic Pile of two Elements, &c., by* M. Zamboni.—M. Zamboni has constructed a new voltaic pile, containing only two elements, the one a metal, the other a fluid. He has called it the *binary pile.* In its construction it is necessary that the fluid should be an, imperfect conductor, as, for instance, water; and that the two elements should be in contact by unequal surfaces. The following is the most simple process:—Small square pieces of tin-foil, half an inch in the side, are to be cut out, having a very fine slip, or tail, of the metal, two or three inches long, left adhering to them; these are the metallic elements of the pile. Place thirty watch glasses in a circle, on a well insulated surface, and fill them to a certain height with distilled water; communicate them one with another, as in the *couronne de tasses*, by placing the pieces of metal across the edges of the two contiguous glasses, always

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in the same direction, and so that the square portion may be entirely immersed in the water of one glass, whilst the tail barely touches that in the next. The circle remaining open, communicate one of its extremities with the earth, and the other with a good condenser; and it will be found that the apparatus has two poles, that corresponding to the squares of metal, being vitreous (positive), and the other resinous (negative).

An apparatus similar to the preceding, the metallic elements of which are long parallelograms, will not give any electric signs, whilst the pieces of metal are plunged into the water equally at both extremities; but as soon as they are unequally immersed, the electricity becomes evident at the two poles, as in the preceding apparatus; the vitreous pole always corresponding to the metallic surface the farthest in the water, so that the same pole may be made either positive or negative, by plunging the metallic extremities, which correspond to it, more or less into the water.

The same effects are produced by using zinc, and even copper, in place of tin, but oxide of manganese produces no effects.

The binary pile does not charge the condenser immediately; the electricity does not become evident in less than half a minute, or even a longer period, and it increases by degrees. It may be supposed that this effect is produced by the oxidation of the tin, as then the pile would have three elements; but at the end of many days, the electric tension was the same as at its first arrangement, though not the slightest trace of oxidation could be perceived. That the developement of electricity by the binary pile is not produced by oxidation is proved also by the circumstance, that in using zinc in place of tin, the electricity diminishes as the oxidation increases, until it disappears, after which it again re-appears, but in the contrary order.

A pile constructed of ten discs of tinned paper, without the addition of any other substance, gave to Bennet's electrometer, combined with a condenser, a divergence of the third of an

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inch in about half a minute. The metallic face was vitreously electrified, and the paper end resinously. The effect constantly augmented with the number of discs. Another pile of tinned paper discs, of which the reverse sides had been covered with honey, to preserve a constant humidity, also gave electricity, but it required forty or fifty discs to equal the effect of the preceding ten and the electricity was changed, for the metal was resinous and the honey vitreous. On the following day there was scarcely any electricity, and it soon entirely disappeared, in consequence of the paper becoming penetrated by the honey, when the metal was equally in contact with it on both sides. A pile of tinned paper, of which the discs were pasted together, gave no electric signs, because the metal was equally in contact with the paper on both faces.

When a pile of this kind has become inactive, it may be renewed by separating the discs, and airing them, so as to diminish the effect of moisture on one of the faces of each disc. In general, binary piles only produce their effect by the inequality of contact between the faces of the metallic and humid elements.

The conducting power of the fluid has a very great influence on the energy of these piles. A few drops of a solution of an ammoniacal salt added to the water, somewhat augments the electric tension, a second addition diminishes it, and, at last, by continuing to add the salt, it is entirely destroyed. It is necessary, therefore, that the fluid element of the binary piles should be an imperfect conductor.

With respect to the pile constructed of tinned paper, and the black oxide of manganese, M. Zamboni directs, that as tinned paper alone forms a pile, a paper should be chosen, which, when disposed alone in a pile, has the same electricity as when the oxide of manganese is used. But with whatever kind of tinned paper the pile be made, it is always increased in energy, and its electricity corresponds with that of a pile constructed with tinned paper and oxide of manganese, when the paper has been impregnated with a solution of sulphate of zinc, and afterwards dried.

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M. Zamboni waits for dry weather, when he would prepare paper for the construction of his piles. After having spread the solution of sulphate of zinc on the side of the paper which is not tinned, it is dried, but without separating the water which belongs to the paper; this side is then covered with very dry oxide of manganese, and the pile being made, particular care is taken to preserve it from the action of the air. The paper should be thin and unsized, if it is otherwise, alcohol should be added to the solution of sulphate of zinc. M. Zamboni has ascertained, from long experience, that the best method of preserving the pile is to enclose it in a tube of flint glass, of a diameter somewhat larger than that of the discs, and to pour into the intermediate space a warm cement of wax and turpentine. A pile of 2,000 discs, constructed in this way, gives a spark visible by day. M. Zamboni directs also, a perfect insulation of all those parts which require it.—*Annales de Chimie*, xi. p. 190.

5. *Human Electricity.*—Dr. Hartmann of Francfort on the Oder, has published in a German Medical Journal, a statement, according to which he is able to produce, at pleasure, an efflux of electrical matter from himself towards other persons. The crackling is to be heard, the sparks seen, and the shocks felt. He has now, it is asserted, acquired this faculty to so high a degree, that it depends on his own pleasure to make a spark issue from his finger, or to draw it from any other part of his body. All this is so strange, that it risks being classed with the reveries of animal magnetism.

§ 3. Medicine, Anatomy, &c.

1. *Medical Benevolent Society.*—The great number of societies which have been formed in different parts of the kingdom, within the last 30 or 40 years for the relief of the Widows and Orphans of Medical Practitioners, must be a durable, and at the same time very honourable, memorial of the good sense and active benevolence of the members of that profession. Though the utility of these institutions is indisputable, yet it has, unfor-

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tunately too often happened, that widows and orphans are not the only persons connected with this profession, who have been the subjects of want and distress, but that practitioners themselves have become from various causes exposed to so many difficulties and privations, as to have been equally, if not in a superior degree, objects of commiseration.

We have great pleasure, therefore, in announcing to the medical public, that an Institution was founded about three years ago, under the name of the MEDICAL BENEVOLENT SOCIETY, for the purpose of raising a fund for the relief and assistance of such of its members, who may, through want of success in business, or unforeseen misfortunes, be so reduced in their circumstances as to stand in need of pecuniary aid. This society is ready to receive into its number regular practitioners, in every branch of the profession, throughout England and Wales. The subscription of one guinea at admission, and the same annually, (paid in advance) constitutes a member, and entitles him, in case of need, to such advantages as the future state of the fund shall be able to afford. It must surely, then, be considered as a duty incumbent upon every medical man, without any exception, to unite with such an institution. The more opulent, for the benefit of that class of their brethren (which is, alas! too numerous) whose situation is that of entire dependance upon the uncertainty of professional success; and the latter class as not knowing but ill health, infirmity, or old age, may overtake them, before they shall have been able to make provision for a period of life which must from these causes be utterly unable to provide for itself.

Though this society is but in its infancy, it consists already of between 200 and 300 members, and is under the special patronage of his Royal Highness the Duke of Sussex; Dr. John Latham, president of the Royal College of Physicians, presides over it, and its vice-presidents are, Dr. Hull of Manchester, Henry Cline, esq., Surgeon, and Arthur Tegart, esq., Apothecary to their Royal Highness the Dukes of Clarence and Kent. Among its members will be found the names of Drs. Baillie, Ainslie, and Babington; and Messrs. Abernethy, and Astley Cooper,

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Surgeons. At the quarterly meeting of the Directors, held in September, seven new members were ballotted for, and admitted.

In addition to the benevolent fund above mentioned, there is, under the same board of managers, another fund, totally distinct from the former, for the purpose of granting Annuities of £50, or £100, during the lives of medical subscribers to it, after they shall have attained the age of 60 years. The payments for this purpose are regulated by the age of subscribers at the time of their admission, agreeably to well-known rules of calculation, settled under the direction of an eminent mathematician, and may be made either in one sum or by annual instalments, at the option of the party insuring. Further particulars, relative to both these funds, may be known by application (if by letter, post-paid,) to the secretary,

Mr. H. C. Field, Surgeon, 95, Newgate Street, London.

2. *Effects of Cinchona.*—An account has been published in the *Journal de Pharmacie*, for May, of some curious effects produced by Peruvian Bark. A French merchant, M. Delpech residing at Guayra, in the Caraccas, had stored up a large quantity of fresh cinchona, in apartments which were afterwards required for the reception of some travellers as guests. These apartments contained each eight or ten thousand pounds of bark, and in consequence of its fermentation, the heat was much greater here than in the other parts of the house, rendering the place somewhat disagreeable. One of the beds placed in these rooms, was occupied by a traveller, ill of a malignant fever; after the first day he found himself much better, though he had taken no medicine; in a few days he felt himself quite recovered without any medical treatment whatsoever. This unexpected success induced M. Delpech to make some other trials: several persons ill of fever were placed successively in his magazine of cinchona, and they were all speedily cured, simply by the effluvia of the bark.

It happened that a bale of coffee and some common French brandy were kept in the same place for some months; one of the brandy bottles happened to be uncorked, and on examina-

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tion it was found to possess a slight aromatic taste, to be more tonic and very superior to common brandy. The coffee also was much altered; when roasted it was more bitter than common coffee, and left in the mouth a taste similar to that of an infusion of bark.

It is to be observed that the bark which produced all these effects was fresh; and the question whether that of commerce would produce the same effects can only be answered by experiment.

3. *The African Plague.*—His Majesty's ship, which was lying in the port of Alexandria, when Colonel Fitzclarence passed through Egypt, from India, on his way to England, convoyed to Tangier a vessel which had on board two of the sons of Muley Soliman, emperor of Morocco; on their arrival at Tangier, the princes immediately landed and proceeded to their father at Fas; but it was discovered by the governor or alkaid of Tangier, that during the passage some persons had died; and accordingly the Alkaid would not suffer any of the passengers to land, except the princes, until he should have received orders from the emperor how to act; he accordingly wrote to Fas, for the imperial orders, and in the mean time the princes arrived, and presented themselves to the emperor: the latter wrote to the alkaid, that as the princes had been suffered to land, it would be unjust to prohibit the other passengers from coming ashore also. He therefore ordered the alkaid to suffer all the passengers, together with their baggage, to be landed, and soon afterwards the plague appeared at Fas, and at Tangier. Thus the contagion which is now ravaging west Barbary was imported from Egypt. It does not appear that the mortality is, or has been during its acme at Fas, any thing comparable to what it was during the plague that ravaged this country in 1799* and which carried off more than two-thirds of the population of the empire.

* It has been asserted by a physician who has lately written, *Observations on Contagion, as it relates to the Plague and other epidemical diseases*

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Whence proceeds this difference? is it a different species of plague, and not so deadly a contagion? or is it because the remedy of *olive* oil, applied and recommended generally by me and by some other Europeans during the plague of 1799, is now made public and generally administered? This is an inquiry well deserving the attention of scientific men. And his Majesty's ministers might procure the information from the British Consul at Tangier, or from the governor of Gibraltar: perhaps the truth is, that the contagion is of a more mild character.

With regard to the remedy of olive oil applied **internally*, I should, myself, be disposed to doubt its efficacy unless M. Colaco, the Portuguese consul at L'Araich, is competent to declare, *from his own knowledge and experience*, that this remedy has been administered effectually by him to persons having the plague, who did not *also use the friction with oil.* I say, till this can be ascertained I think the remedy of oil applied *externally*, should not be forsaken; as *it has been proved during the plague in Africa, in* 1799, *to be*

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reviewed in article 20th of the *British Review*, and *London Critical Journal*, published in May last, that I have asserted that the deaths during the prevalence of that disorder in West Barbary in 1799, amounted to 124, 500; but on a reference to my account of Morocco, Timbuctoo, &c., 2d or 3d edition, note, page 174, it will appear, that this mortality, was that of two cities, and two sea-ports only, viz., the cities of Fas and Morocco, and the ports of Saffy and Mogodor; the mortality, however, was equally great in the imperial cities of Mequinas, and Ferodant, and in the sea-port towns of Tetuan, Tangier, Arzilla, Laraiche, Salee, Rabat, Dar el Vieda, Azamore, and Mazagan, and Santa Cruz, or Agadeer; and considerably greater among the populous and numerous encampments of the Arabs, throughout the various provinces of the empire; not to mention the incredible mortality in the castles, towns, and other walled habitations of the Shellah province of Haha, the first province, travelling from the shores of the Mediterrannean, where the people lived in walled habitations, the sea-ports excepted.

*Mr. Colaco, having lately observed that oil was used externally to anoint the body, as a preservative against the plague; conceived the idea of administering this simple remedy *internally* to persons already infected; numerous experiments were made by this gentleman, and out of 260 individuals already infected, who resorted to this remedy, only 12 died.

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infallible, and therefore indispensable to people whose vocation may lead them to associate with or to touch or bury the infected. For the rest, such persons as are not compelled to associate with the infected, may effectually avoid the contagion, however violent and deadly it may be, by avoiding contact. I am so perfectly convinced of this fact from the experience and observation I have made during my residence at Mogodor, whilst the plague raged there in 1799, that I would not object to go to any country, although it were rotten with the plague, provided my going would benefit mankind, or serve any useful purpose; and I would use no fumigation, or any other remedy but what I actually used at Mogodor in 1799, which I have detailed in the description of the plague, inserted in my account of Morocco, Timbuctoo, *&c.*, I am so convinced from my own repeated and daily experience, that the most deadly plague is as easy to be avoided BY STRICTLY ADHERING TO THE PRINCIPLE OF AVOIDING PERSONAL CONTACT AND INHALATION, AND THE CONTACT OF INFECTIOUS SUBSTANCES, that I would ride or walk through the most populous and deeply-infected city, as I have done before, without any other precaution than a segar in my mouth, when by avoiding contact and inhalation, I should most assuredly be free from the danger of infection!!

When these precautions are strictly observed, I maintain (in opposition to all the theoretical doctrines that have lately been propagated) that there is no more danger of infection with the plague, than there is of infection from any common cold or rheum.

JAMES GREY JACKSON.

4. *Relation of a Phenomenon.*—By L. A. D'Hombres Firmas. "A female kid was killed by a traiteur of Alais, in which was found a well-formed small fœtus. Many persons saw it; I did not see it myself, but I can assure you, that Messrs. Champagne who bought it, Dumas the butcher who killed it, and Jammes, clerk of the customs, one of the witnesses present, from whom I have taken these details, merit full confidence."

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This young kid, brought to Alais by a countryman of the neighbourhood, appeared to be between fifteen days and three weeks old. It had not yet began to eat. It was well formed, strong, and fat, and weighed about five kilogrammes (about 11 lbs.)"

When it was opened the butcher was astonished to observe that the uterus was swelled, and that it contained a skin, full of a clear fluid, in which swam a fleshy body the size of the little finger, and he made the traiture, and those around him remark these circumstances. All recognised it as an embryo, and compared it with those which they had observed many times in the slaughter-houses, at the killing of sheep. They could not be deceived in the position of the uterus. The butchers, without being anatomists, know that organ and its uses very well, and as to that which they took for a fœtus, supposing it had not been so well formed, as they declared, still the presence of a strange body in the uterus, and its envelope full of fluid, would indicate a sort of generation."

After observing that this is more extraordinary than any other known instance of monstrous generation, M. D'Hombres Ferman says, " There are only two ways of explaining it: either the kid and the fœtus it contained must be contemporaneous, dating from the same moment, when during the five months their common mother carried them, and whilst the kid sucked it increased and grew in the common way, whilst its twin, nourished but imperfectly, could not be developed in its interior ; or else, if this interposition of germs cannot be admitted, it must be supposed with some naturalists, that the fœtus existed before fecundation, a series of animals being enclosed one in another since the creation of the world and becoming developed in succession, &c." *Journal de Physique, July*, p. 63.

5. *Prize Questions.*—Royal College of Surgeons in London—Jacksonian Prize. One of the Prizes for the year 1818, not having been adjudicated, two Prize subjects are proposed for the year 1820, *viz.*—*Diseases of the Skin*, and *Diseases of the Rectum.*

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The candidates to be Members of the College, not on the Court of Assistants. Dissertations to be in English, and the number and importance of facts will be considered principal points of excellence. Each dissertation to be distinguished by a motto or device, and accompanied by a paper sealed up containing the name and address of the author, and having on the outside a motto or device corresponding with that on the dissertation. No dissertation, nor motto or device, to be in the hand-writing of the author, nor sealed paper to have the impression of his seal. Dissertations to be delivered to the Secretary, at the College, before Christmas-day, 1820. Those that are unapproved of, will be returned on authenticated application.

The Prize subject for the present year is, *The treatment of morbid local Affections of Nerves.* To promote the knowledge of which, it is required that a minute dissection of the nerves of the cervical portion of the Medulla Spinalis, and of their communications with other nerves, be made; and it is expected that such dissections be authenticated by preparations of the dissected parts.

Dissertations to be delivered at the College before Christmas-day next.

IV. General Literature, &c.

1. *Comparative Table of the Extent, Population, Riches, Debts, Revenues, and Taxes, of Great Britain and France, for the year* 1819.

	Great Britain and Ireland.		France.
Surface	21,114,000	hect.	52,000,000
Population	12,600,000	ind.	29,827,000
Agricultural Capital	61,000,000,000	fr.	57,522,000,000
Gross produce of Agriculture	3,875,000,000		4,679,000,000
Net produce ditto	1,461,200,000		1,345,000,000
Gross produce of Manufacturing Industry ..	2,250,000,000		1,404,000,000
Horses, Mules, &c.	1,818,000		1,657,000
Oxen, &c.	7,200,000		4,682,000

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	Great Britain and Ireland.	France.
Sheep, &c.....	40,860,000	35,189,000
Value of Exports	1,000,000,000	370,000,000
Cotton imported & wrought	25,000,000	10,500,000
Public Debt	20,000,000,000	3,050,000,000
Interest thereon	1,000,000,000	232,000,000
Revenue of the state	1,500,000,000	889,210,000
Proportion of Individuals	1,800,000,000	827,790,000

(Gazette de France.)

The population of Great Britain and Ireland is, according to the best authorities, about 17,000,000 souls.

2. *Scientific Expedition.*—A steam-boat is to be launched at Pittsburgh, to be employed in an expedition to the Yellow Stone River; the object of which is to obtain a history of the inhabitants, soil, minerals, and curiosities. Major Long, of New Hampshire, topographical engineer; Mr. Graham, of Virginia; Mr. Wm. H. Swift of Massachusetts, from the military academy; Major Biddle, of the artillery; Dr. Jessup, mineralogist; Dr. Say, botanist and geologist; Dr. Baldwin, zoologist and physician; Mr. Peale, of Philadelphia, landscape painter and ornithologist; Mr. Seymour, ditto; and Major Fallow, of the Indian department, form the expedition. The boat is 75 feet long, 13 beam, draws 19 inches water, and is well armed; she carries on her flag a white man and an indian shaking hands, the calumet of peace, and the sword. Her machinery is fixed to avoid the snap and sawyers of the rivers. The expedition has the best wishes of the lovers of science.

3. *German Universities.*—The disturbances connected with the Universities of Germany, appear to have had considerable effect upon the number of Students belonging to them. Formerly Gottingen reckoned more than a thousand students; but from a late estimate it appeared to have only 770. Halle has 500; Breslau has 366; Heidelberg has 363; Gressen has 241; Marburgh has 197; Kiel has 107; Rostock has 160; Greifs-

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wald has 55; Landshut has 640; Tubingen has 698; Berlin has 942; Leipsic has 911; Jena has 634; Vienna has 957; and Prague has 880. The whole number is 8,421 in the sixteen principal Universities of Germany.

4. *Swedish Universities.*—The Universities of Sweden are in a very flourishing state. In the first quarter of this year the number of Students at Upsal amounted to 1,197, and those of Lund to 600. The whole of the establishments of the kingdom professing to communicate classical education, contained 3,485 scholars. These establishments cost the state annually about £60,000; of which £4,000 is employed in the maintenance of youth during the course of their studies, in cases where such assistance is wanted.

5. *Suicides in Paris.*—The number of suicides committed and attempted in Paris and its environs in the four months of January, February, March, and April, amounted to 124. Of these persons 33 were women; 64 of them were single, and 60 had been married. The greater number destroyed life by the use of fire arms, the vapour of charcoal, or by drowning: 46 resorted to the last method. This period of the first four months of this year, compared with the same period of the last year, offers an excess of 41 suicides.

By the end of June the number amounted to 199, of which 137 were committed by men, and 62 by women: 102 of these were married, and 97 were unmarried. These have been arranged in a sort of scale according to the causes, thus—for love, 17; illness, distaste of life, insanity, domestic trouble, 65; bad conduct, gaming, lottery, 28; misery, poverty, deranged affairs, 47; fear of reproaches and punishment, 6; unknown motives, 36; in the whole 199, of which 53 were unsuccessful attempts, and 146 were completed.

6. *Search of the Tiber and Pompeia.*—The search of the Tiber has commenced at Rome, but it is said with but little success.

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The excavations at Pompeia are carried on very successfully, and several new edifices are said to have been discovered in the street which leads to the Temple of Isis, to that of Hercules, and to the Theatre. Some surgical instruments, of good workmanship, are described to have been found.

7. *New Scientific Establishment at Bath.*—It is proposed to form in Bath an Institution for the cultivation of Science, Literature, and the Liberal Arts.

The Institution to consist of a house and establishment, comprising the following accommodations: namely, a library and reading-room, from which newspapers and political pamphlets shall be excluded; a botanic garden; a museum of natural history; a cabinet of mineralogy; a cabinet of antiquities; a cabinet of coins and medals; a hall for lectures, with suitable apparatus for the courses on chemistry and the several branches of natural philosophy.

To these will be added an exhibition gallery, for the reception and display of paintings and other works of the fine arts.

The funds to be raised by subscriptions for shares of £50 each, and the right of property to be vested in the subscribers.

The incorporation of the subscribers to take place under a Legislative Charter.

The management of the Institution to be conducted by a Board of Directors.

The Institution to be open to annual and life subscribers.

A capital sum of thirty thousand pounds will be required for carrying the general purposes into effect. Twenty thousand pounds to be disposable in the purchase of premises, erecting the necessary buildings, and fitting up the Institution in a suitable manner; and ten thousand pounds to form a reserved fund, the interest of which shall be applicable to defraying the annual expenses.

No active proceedings to be commenced, until there shall be subscriptions for at least 300 shares.

The Provisional Constitution of the intended Establishment

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may be inspected at the Treasurer's, Messrs. Cavenagh and Co., by those who may wish for more full and precise information previously to subscribing.

The amount of subscription will be taken by instalments of sums not exceeding five pounds, and at intervals not shorter than three months.

8. *Prospectus of a work to be entitled Hieroglyphics, collected by the Egyptian Society.*—The triple Inscription of Rosetta having afforded a prospect of the partial interpretation of the Egyptian hieroglyphics in general, it becomes a matter of high importance, for the advancement of literature and of the study of antiquities, to collect and preserve all the remains of the Hieroglyphical Inscriptions and Manuscripts, which have hitherto escaped the injuries of time. For this purpose, the efforts of a single individual would probably be too feeble, and the duration of a single life might possibly be too short: but it may be effected with much more ease, and with far greater certainty, by the continued co-operation of a select Society, determined to keep it constantly in view.

The process of lithography affords a ready mode of obtaining a moderate number of copies of a drawing at a cheap rate. The object of this collection being to exhibit perfectly correct representations of the greatest possible extent of materials for a limited sum, the introduction of any unnecessary ornament would obviously be inconsistent with its complete attainment; and the delineation of all works of art, as such, must, for the same reason, be excluded.

It will naturally be desirable to select, in the first instance, in order for their permanent preservation, such inscriptions and manuscripts as have not yet been published; but it is intended that the work should ultimately comprehend every thing of the kind that can be obtained; not only because some of the most important materials are thinly scattered through a variety of magnificent and expensive works, but also because such a collection would afford a very great convenience, both for study and for

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reference, even to those who are already possessed of the original works which contain them.

In order to avoid the introduction of arbitrary hypotheses and erroneous conclusions, no commentaries, nor even any particular nomenclature, will be admitted into this series of hieroglyphics. It was indeed in contemplation to have begun the work with a copy of the Inscription of Rosetta, subdivided, and having the parallel passages of the three texts printed together, according to the arrangement of the anonymous translation published in the Archæologia; but it has been thought more advisable to defer this comparison, in the hope that some of the duplicates of the stone, which have remained more entire, may speedily be obtained from Egypt.

The general subjects of the Hieroglyphical Inscriptions, which they contain, may be collected from an article on Egypt, which is about to appear in the Supplement to the *Encyclopædia Britannica.* The first six exhibit a tolerably perfect specimen of the manuscripts frequently found with mummies, and which always contain a series of homages, addressed to the different deities in the name of the deceased: the next subject consists of friezes brought from Egypt, and now in the British Museum, compared with another fragment of the same series found in the ruins of Rome. The colossal head, which has lately been presented to the British Museum in the names of Mr. Salt and Mr. Burckhardt, occupies the greater part of the 10th plate; and the subjects delineated in the five following plates are more or less immediately connected with this figure, exhibiting either the name, which is still distinguishable in the inscription on the back, or that of Memnon, whom the head has sometimes been supposed to represent, or some other name approaching very near in its form to one or the other of these two.

The execution of the work is so arranged as to afford the subscribers the greatest possible benefit for their contributions; and *not only the whole of the money collected will be employed for defraying the expenses, but some further voluntary assistance may be expected* from individuals; a nobleman, who has travelled in

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Egypt, having already set the example, by taking upon himself the expense of the drawings of a valuable hieroglyphical MS. which he has lately received from the British Consul at Cairo.

Each Subscriber will be required to pay *One Guinea* in advance at the time of subscribing, and *Two Guineas* annually upon the receipt of each volume, which will probably contain from 20 to 50 folio plates.

No copies will be sold, except to those who may become subscribers at a future time; and in such cases the amount of the sale will be carried to the account of the society, of which an annual statement will be laid before the subscribers. A copy will be deposited in the British Museum, another in the King's Library at Paris, a third in the Vatican, and a fourth in the Academical Library of Göttingen. Other public libraries will be admissible as subscribers, it not being intended to limit in any manner the description of persons subscribing, nor the number of copies which they may wish to take.

The management of the work, and any further proceedings of the Society, which may be thought advisable, will rest entirely with the Directors, who will also have the power of making, from time to time, such additions to their own number as they may think proper. For the present, Taylor Combe, Esq., William Hamilton, Esq., Lieut.-Col. Leake, the Earl of Mountnorris, and Matthew Raper, Esq., have undertaken the responsibility of this office.

Subscriptions will be received by Mr. Yeoman, Collector to the Society, No. 3, Lincoln's Inn Fields.

9. *Prize Questions.*—The Royal Academy of Inscriptions and Belles Lettres at Paris, have proposed the following prize subject for the year 1821:—"To compare the monuments which remain of the ancient empire of Persia and Chaldea, either edifices, basso-relievos, statues, or inscriptions, amulets, coins, engraved stones, cylinders, &c., with the religious doctrines and allegories contained in the *Zend Avesta*, and with the indications and data which have been preserved to us by Hebrew, Greek, Latin, and Oriental writers, on the opinions and customs of the Persians

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and Chaldeans, and to illustrate and explain them as much as possible by each other."

The prize is a gold medal of 1,500 francs value. The essays are to be written in Latin or French, and sent in before the 1st of April, 1821. The prize will be adjudged in July following.

The Society of Sciences, Arts, and Belles Lettres at Dijon has proposed the following question as the subject for the prize to be awarded in 1820:—"What may be the most effectual means of extirpating from the hearts of Frenchmen that moral disease, a remnant of the barbarism of the middle ages; that false point of honor which leads them to shed blood in duels, in defiance of the precepts of religion and the laws of the state?"

10. *Prizes proposed by the Royal Academy of Copenhagen.—Mathematics.*—Num inclinatio et vis acus magneticæ iisdem, quibus declinatio diurnis variationibus sunt subjectæ? Num etiam longiores, ut declinatio, habent circuitus? Num denique has variationes certis finibus circumscribere possumus?

Quibus naturæ legibus rejetur primaria evolutio corporum animalium, ut formam sive regularem, sive abnormem abscissant.

The prizes attached to these subjects are 50 Danish ducats.

Geology.—Quæ Saxa ad montes ordinis secundi, seu transitorios, pertinentia in Norwegia reperiuntur?

This prize proposed by his Excellency S. G. Moltke, is of the value of 550 rubles. The memoirs are to be written in Latin, French, English, German, Swedish, or Danish, and should be directed to M. H. C. Orsted, Secretary to the Academy, by December 1819.

11. *Scientific Questions.* The Royal Academy of Sciences and Belles Lettres of Brussels have proposed for competition, during the year 1820, the following questions in the department of science:

1. Suppose a plate of a given figure, attached to a surface either by means of screws of a known number, position, and force, or by means of some intermediate matter capable of uniting the one to the other solidly, and the specific tenacity of

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which is also known; if to a point in the circumference of this plate, an arm be affixed, which acts in the same plane with the surface, it is required to know what resistance this plate will be capable of making against a force applied to this arm as a lever, considering the material, as well of the plate as of the arm and surface, as a perfect mathematical abstraction; that is to say, as perfectly rigid or non-elastic, as infrangible or incapable of breaking, &c. ?

2. A body being suspended from the extremity of a cord, the other extremity of which is fixed to the roof of a room; if this body is made to describe an arc of a certain circle round the fixed extremity; and if, besides, a movement of projection is given to it,—it is required to know the nature of the curve, or rather double curvature, which this body will describe according to the hypothesis—As is the resistance of the air, so is the square of velocity?

3. If there is an identity between the forces which produce the electrical phenomena, and those which produce the galvanic phenomena, whence is it that we do not find a perfect accordance between the former and the latter.

4. Many modern authors believe in the identity of the chemical and galvanic forces,—it is required to prove the truth or falsity of this opinion.

5. What is the true chemical composition of sulphurets, as well oxidized as hydrogenized, made according to the different processes, and what are their uses in the arts?

The answers are to be supported, as far as possible, by new facts and experiments easy of repetition.

12. *Death of M. Benedict Prevost.*—Announced in a letter to the editors of the *Bibliothèque Universelle.*

Geneva, June 29, 1819.

MM.—I have received information of the death of a relation whom you will regret as much as I do. J. Benedict Prevost, born at Geneva, Aug. 7, 1755, died at Montauban, the 18th of June, 1819. From his earliest youth he evinced a decided taste for study. This taste was opposed by circumstances, and could

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not be developed but at the time when he settled at Montauban. Intrusted with the education of the son of M. Delmas, a merchant of that town, he resolved to complete his own. He gave himself to the sciences with ardour, and succeeded in making friends, or rather true brothers, of his pupils, insomuch, that, having lived with them 40 years, he died in their arms. He was Professor of Philosophy to the Protestant Theological Faculty of Montauban, member of several learned societies, and known by his numerous memoirs in Natural Philosophy and Natural History, on the Rot in Corn, on Dew, &c. I have neither time nor opportunity to detail all his works, and still less to describe his amiable character, and talk of his virtues. These valuable details must be reserved to another time; I shall here only say that M. Ben. Prevost, happy in the family that had received him, and cherished by those who had given him an asylum, sought not to form new connexions. He has left his friends in sorrow, but I feel happy in being the first to pay to his memory this slight tribute of affection and grief.

P. Prevost.

13. *Death of M. Faujas de Saint Fond.*—Science has lately lost M. Faujas de Saint Fond, a distinguished mineralogist and geologist. He was born at Montelimart in 1750, and died last July (1819,) at Soriel, near Valence. He was Professor of Geology to the Museum of Natural History, from the time of its establishment; he has enriched its collections by a vast number of curious objects, the results of his researches and travels; and France owes to him the discovery of one of its richest iron mines. M. Faujas has published many works on mineralogy and geology, as well as numerous memoirs in the *Annales du Muséum d'Histoire Naturelle.* He has left a collection of minerals, shells, and alluvial fossils, among which are many extremely rare specimens, and of which the selection announces a professor who desired to rest upon facts to the utmost possible.

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ART. XV. METEOROLOGICAL DIARY for the Months of June, July, and August, 1819, kept at EARL SPENCER'S Seat at Althorp, in Northamptonshire. The Thermometer hangs in a North-eastern Aspect, about five feet from the ground, and a foot from the wall.

For June, 1819.

		Thermometer.		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Tuesday	1	48	68.5	29.83	29.80	WbS	W
Wednesday ..	2	42	73	29.88	29.85	W	WbS
Thursday	3	46	68	29.85	29.85	S	SW
Friday	4	55	78.5	29.80	29.75	SW	W
Saturday	5	43	71.5	29.87	29.85	W	W
Sunday	6	41	70.5	29.93	29.79	SW	SE
Monday.....	7	46	69	29.47	29.52	SW	SW
Tuesday	8	49	67	29.50	29.46	SE	SE
Wednesday ..	9	45	70.5	29.50	29.50	WSW	WSW
Thursday	10	47	72	29.42	29.54	SW	WSW
Friday	11	42	72	29.72	29.83	W	W
Saturday	12	46	70	29.88	29.92	W	W
Sunday	13	37	69	29.97	29.98	SW	WSW
Monday.....	14	46	68.5	29.98	29.79	W	W
Tuesday.....	15	49	66	29.65	29.68	S	W
Wednesday ..	16	48	68	29.79	29.88	W	WbN
Thursday	17	48	84	29.98	30.00	NW	EbN
Friday	18	58.5	82.5	29.99	30.00	NW	NW
Saturday	19	51	68	30.03	30.03	NW	NW
Sunday	20	46	68.5	30.10	30.12	WbN	W
Monday.....	21	44	72	30.09	30.00	W	NW
Tuesday.....	22	45	65	29.97	29.97	W	WbN
Wednesday ..	23	45	68	29.92	29.97	W	W
Thursday....	24	48	68	29.76	29.68	W	W
Friday	25	52	82	29.61	29.63	WbN	SW
Saturday	26	54	85.5	29.59	29.60	SW	W
Sunday	27	46	69	29.54	29.52	WbS	NE
Monday.....	28	45	72	29.57	29.80	WbS	W
Tuesday.....	29	44	82	29.70	29.72	W	W
Wednesday ..	30	52	89	29.80	29.83	W	W

For July, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Thursday	1	46	68	29.70	29.74	W	W
Friday	2	47	67	29.76	29.87	W	SW
Saturday	3	58	72	29.83	29.66	W	W
Sunday	4	58	88	29.70	29.70	SE	W
Monday.....	5	57	78	29.74	29.75	WbN	E
Tuesday.....	6	53	85.5	29.83	29.86	E	E
Wednesday ..	7	55.5	76	30.02	30.02	NW	EbS
Thursday	8	51	73	29.96	29.96	W	WbN
Friday	9	55	75	30.04	30.04	W	NW
Saturday	10	56	70	30.02	29.95	W	W
Sunday	11	51	69.5	29.99	30.00	W	W
Monday.....	12	56.5	72	30.00	30.01	NW	NE
Tuesday.....	13	58	69.5	30.10	30.09	NE	NE
Wednesday ..	14	53	71	30.09	30.08	NE	NE
Thursday	15	47	69	30.00	29.98	NE	W
Friday	16	49	68.5	29.94	29.90	W	W
Saturday	17	50.5	72.5	29.92	29.85	WbS	W
Sunday	18	51	73.5	29.86	29.76	WbS	SW
Monday.....	19	58	74	29.85	29.89	SE	N
Tuesday.....	20	59.5	69	29.87	29.90	NW	NNW
Wednesday ..	21	58	61	29.93	29.89	WbN	NW
Thursday	22	48	69	29.86	29.91	NE	W
Friday	23	43	77.5	30.04	30.04	WbN	NE
Saturday	24	54	80.5	30.06	30.06	E	EbS
Sunday	25	55	78	30.00	29.90	E	EbN
Monday.....	26	53	79	29.82	29.86	EbN	E
Tuesday.....	27	58	80	30.03	30.08	E	E
Wednesday ..	28	57	73	30.10	30.10	N	E
Thursday	29	57.5	77	30.10	30.06	NE	NE
Friday	30	55	77.5	30.06	30.00	NE	NE
Saturday	31	57	76.5	30.00	29.90	NE	EbN

For August, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Sunday	1	59.5	76	29.94	29.94	ENE	NE
Monday.....	2	59	72.5	29.94	29.85	NE	NE
Tuesday	3	53	72	29.84	29.80	N	NE
Wednesday ..	4	58	70.5	29.80	29.81	NW	NNW
Thursday	5	60	68	29.84	29.87	N	NW
Friday	6	58	73	29.89	29.80	W	WbS
Saturday	7	57	76.5	29.88	29.88	SW	W
Sunday	8	58.5	75	29.95	29.98	NW	NW
Monday.....	9	55	78.5	30.04	30.04	W	E
Tuesday.....	10	53	78	30.04	30.00	E	E
Wednesday ..	11	58	74	29.95	29.89	SE	S
Thursday	12	60	76.5	29.92	29.80	E	W
Friday	13	58.5	75.5	29.80	29.80	WbS	W
Saturday	14	60	77	29.89	29.90	W	W
Sunday	15	51.5	77.5	30.00	30.00	W	W
Monday.....	16	57	76.5	30.08	30.11	W	W
Tuesday.....	17	58	80.5	30.14	30.19	NW	EbN
Wednesday ..	18	61	74	30.24	30.23	NNE	E
Thursday	19	60	71.5	30.19	30.18	EbN	E
Friday	20	58.5	73	30.13	30.12	NE	E
Saturday	21	58.5	76	30.16	30.12	EbN	E
Sunday	22	56	76	30.10	30.07	E	ENE
Monday.....	23	58.5	77.5	30.07	30.00	NE	NE
Tuesday.....	24	55	81.5	30.56	29.93	NE	NW
Wednesday ..	25	60	73.5	29.90	29.90	NE	NE
Thursday	26	58	73	29.89	29.89	NE	NW
Friday	27	56	76	29.89	29.84	W	NE
Saturday	28	59	70.5	29.80	29.78	E	EbS
Sunday	29	53.5	75	29.80	29.47	SW	SW
Monday.....	30	59	71	29.33	29.66	SW	S
Tuesday.....	31	51	68	29.10	29.20	SW	W

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THE

QUARTERLY JOURNAL,

January, 1820.

ART. I. *Observations on the Medico-Chemical Treatment of Calculous Disorders, by* William Thomas Brande, Sec. R. S., *&c. Continued from page* 72.

SECTION III. *On Calculi of the Bladder; their Nature and Treatment.*

THE last division of this subject relates to calculi of the urinary bladder: their history, as connected with my present object, may be detailed under the heads of their composition and formation, and their symptoms and treatment.

The chemical constituents of these calculi, have already been enumerated, and their leading characters pointed out; they are

Uric acid.
Ammonio-magnesian phosphate.
Phosphate of lime.
Oxalate of lime.
Cystic oxide.

But their formation will require a more extended inquiry.

From what has been formerly stated, when speaking of kidney calculi, it will appear obvious that the most common proximate cause of cystic calculus is the lodgment of a small uric calculus in the bladder, since the majority of kidney calculi are formed of that substance.

Such a nucleus being lodged in the bladder, it rarely happens

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that it remains for any time without undergoing an increase of bulk, the nature of which will chiefly depend upon the state of the urine, which, if charged with uric acid, will deposit it in layers, thus causing the growth of the calculus in that substance; or if there be no excess of uric acid, the deposition will be of the phosphates. Accordingly, bladder calculi are sometimes almost entirely composed of uric acid, while at others the nucleus only is of uric acid, and the bulk of the stone consists of the triple phosphate of ammonia and magnesia, and phosphate of lime, forming the mixture which Dr. Wollaston, in his valuable paper, has termed *fusible calculus*; (*Phil. Trans.* 1797,) and in which the ammonio-magnesian salt generally predominates.

It deserves notice, as throwing considerable light upon the formation and growth of cystic calculi, that the urine has at all times a tendency to deposit the above-mentioned phosphate upon any body over which it passes: drains by which urine is carried off from the streets, *&c.*, are often incrusted with its regular crystals; and in cases where extraneous bodies have got into the bladder, they have often in a very short time become considerably enlarged by the deposition of the same substance. If, from any cause, the urine becomes in the slightest degree putrid, ammonia is evolved, and the deposition of the phosphates much accelerated and increased. These, as we shall afterwards show, are facts that require always to be borne in mind, as influencing the mode of treatment to be adopted in respect to bladder calculi in general.

The appearance of the triple phosphate is more or less crystalline, and the calculi incrusted with it are generally grayish white. Strongly heated before the blow-pipe, this substance evolves ammonia, and with much difficulty enters into an imperfect fusion; if, however, phosphate of lime be present, it more readily undergoes fusion: hence the propriety of the term *fusible calculus* applied to the mixture of the two phosphates.

Calculi, composed entirely of the ammonio-magnesian phosphate, are very rare; I have seen two; they were crystallized

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upon the surface, and their fracture was somewhat foliated. It is also comparatively rare in its pure state, as an incrustation: I have seen it upon an uric nucleus, in a very large calculus, in the possession of Mr. Thomas.

The fusible calculus is always more friable than the triple; it is generally white, and often much resembles chalk in texture and appearance; it often breaks into layers, and exhibits a glittering appearance when broken, in consequence of the crystals of triple phosphate that have formed in its interstices.

The analysis of fusible calculus is perhaps best performed by distilled vinegar, which, when gently heated, dissolves the ammonio-magnesian phosphate, but not the phosphate of lime, which may be taken up by muriatic acid; and if any uric acid were present it remains as the ultimate residuum, and may be recognised by solubility in caustic potassa, *&c.* (page 67) Or the uric acid may, in the first instance, be separated by solution of caustic potassa, which also expels the ammonia, but has no action on the other ingredients of the calculus.

Calculi, or layers of calculi, composed entirely of phosphate of lime, were first described by Dr. Wollaston under the name of *bone-earth calculi;* their surface is generally pale brown, smooth, and, when sawed through, they are found of a laminated texture, and separate easily into concentric crusts. Dr. Wollaston also notices an appearance which I have often remarked, that of each lamina being striated in a direction perpendicular to the surface, as from an assemblage of crystalline fibres. This calculus is of very difficult fusion. It is soluble in muriatic acid, and ammonia precipitates phosphate of lime from this solution.

The aspect and chemical characters of the uric calculus have already been adverted to. Their texture when formed in the bladder is generally laminated; and when cut into halves, a distinct nucleus of uric acid is almost always perceptible. Their exterior is generally smoother than that of other calculi, excepting those of phosphate of lime.

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It rarely, and perhaps never, happens, that a bladder calculus consists of any of the above substances *perfectly* pure. Traces of the phosphates are discoverable in the uric calculus, and of uric acid in those composed of the phosphates, and the mode of analysis has already been pointed out.

It is, however, a common circumstance to find two or more of the above substances in layers distinct from each other. Uric calculi incrusted with the phosphates are of very frequent occurrence; they are indeed the most common of all calculi. Sometimes the nucleus only is uric, the bulk of the calculus being of the phosphates; at other times a comparatively large uric calculus is incrusted with a thin coat of the phosphates; but I have never yet seen a bladder calculus with a well defined nucleus of the phosphates enveloped in uric acid.

Besides the calculi composed of uric acid and of the phosphates, two other substances have been mentioned as belonging to this formation, oxalate of lime, and cystic oxide.

The properties of oxalate of lime have been described in speaking of it as of kidney origin, but its appearance when concreting into calculi in the bladder is peculiar; their exterior is rough and tuberculated, and their colour deep reddish brown, so that they have been termed *mulberry calculi*. Dr. Marcet (*Essay*, p. 78,) has described a variety of the oxalate of lime calculus not exceeding the size of a pea, of a pale brown colour and crystalline texture, of which he has seen three specimens. The superficial crystals were very flat octoedrons.

The nuclei of these calculi are generally oxalic, and of renal origin, but uric nuclei enveloped in the oxalate also occur; they are likewise not very unfrequently found enveloped by the fusible calculus. I have in my possession a calculus of which the nucleus is uric, surrounded by oxalate and phosphate of lime, and triple phosphate, each in a distinct layer; and Dr. Marcet has depicted a very analogous specimen. (*Essay*, Plate VIII., fig. 8.)

The cystic calculus is rare compared with the other varieties. In appearance it most resembles the triple phosphate, but it is

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somewhat tough when cut, and has a peculiar greasy lustre. It is usually of a pale fawn colour bordering upon straw yellow, and of an irregularly crystalline texture*.

The calculi which have now been described may all be considered as of renal origin, that is, as formed upon nuclei that have passed from the kidneys into the bladder, where they have lodged and increased in bulk, that increase depending at times upon a morbid state of urine, and at times being the simple consequences of an extraneous substance lodged in the urinary passages; in the former case it is uric acid, or oxalate of lime, or cystic oxide; and in the latter, generally speaking, phosphate of lime, or ammonio-magnesian phosphate, or the mixed fusible phosphate

Independent, however, of the ordinary disposition of the urine in its healthy state to deposit the phosphates upon any extraneous matter in the passages, it often acquires a greatly increased tendency to do so in consequence of general disease or local injury. There are, as has already been stated, particular states of stomach and bowels, or of the general health, that favour the formation of the phosphates; local injury of the spine produces an alcaline urine; and when, from any cause, such as stricture, or diseased prostate gland, or calculus, the bladder does not quite empty itself, the remaining portion of urine is

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* Dr. Marcet, in his *Essay on Calculi*, has mentioned two nondescript substances forming concretions in the bladder. One of these he has termed *Xanthic oxide*, from the yellow-coloured compound which it produces when acted on by nitric acid; it is more soluble in water than uric acid, and is distinguished from cystic oxide by its inferior solubility in acids.

The other is called a *Fibrinous Calculus*, and appeared to consist of hardened albuminous matter.

I once met with a calculus having a nucleus of albuminous matter, probably analogous to that described by Dr. Marcet; the specimen I gave to Mr. Wilson, and is, I believe, preserved in the Museum in Windmill-street. I attributed the origin of this stone to a clot of blood having been retained in the bladder during the voiding of a large quantity of uric gravel, which had produced copious hæmorrhage; but I do not think that calculi can often result from such a cause, in consequence of the facility with which any coagula of blood are generally softened and voided.

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very apt to undergo a slight decomposition, in which case it becomes ammoniacal, and more or less of the phosphates will of course be thrown down. This accounts for the circumstance of those calculi which have attained a very large size in the bladder, consisting chiefly of the phosphates; and shews why a similar deposition is often formed upon bougies, or any other extraneous body; why uric nuclei are so often incrusted by phosphates; and why in some cases of diseased kidney a similar deposition has often gone to a great extent.

An enlargement of the prostate gland is not only favourable to the increase of the size of a calculus for the reason which has just been adverted to, but in some instances becomes the cause of the formation of a stone, quite independent of any mischief in the kidneys, or disordered secretion of urine. "The bladder never being completely emptied, the dregs of the urine, if I may be allowed the expression, being never evacuated, a calculus, formed on a nucleus of the ammoniaco-magnesian phosphate and mucus is produced, when it would not have been produced under other circumstances. This species of stone, or a stone upon such a nucleus, can only be produced where the bladder is unable to empty itself; it may therefore be arranged among the consequences of the enlargement of the middle lobe of the prostate gland." (*Home on the Diseases of the Prostate Gland*, Vol. I. p. 40.)

Another way in which any obstacle to the emptying of the bladder becomes a source of mischief in calculous cases, is that under such circumstances, the quantity of urine secreted during a given time is diminished, only eight or ten ounces being in some instances voided during the 24 hours. An illustrative case of this kind will be found in Sir Everard Home's treatise just quoted, (p. 44.) and it always happens that the specific gravity of such urine is greatly above the natural standard, and that it becomes very turbid on cooling, even when voided clear, which, however, seldom happens.

Having now, I believe, enumerated the leading circumstances respecting the composition and formation of calculi of the urinary bladder, it remains to make a few observations upon the

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symptoms that are peculiar to them, and upon the different methods of treatment which they require.

It is not necessary here to enter into the ordinary symptoms of calculus of the bladder, which are so well known, and have been so frequently described; nor shall I, for obvious reasons, notice the uncertainty and difficulty that frequently attends ascertaining the situation and size, and often the existence even of a calculus, by the operation of sounding. The general state of the urine, and of the matters voided with it, are the principal circumstances that bear upon the medico-chemical treatment of this disease; and the passing of different kinds of sand, and of mucus, together with the composition of the urine relatively to its healthy state, are the circumstances to which we must look as those symptoms of the nature and progress of the malady which are chiefly to guide us in its treatment.

Considered in this view, the treatment of calculus was usually pursued upon very erroneous and generally, merely upon empirical principles, until Dr. Wollaston pointed out those differences in the composition of calculi, which I have described, and which were first made known by the publication of his essay in the *Philosophical Transactions* for 1797. Previous to that period it was customary to consider all calculi as of one kind, and soluble in caustic alkalis; these, therefore, became the prevalent remedies, and have continued so even till now, under the absurd name of *solvents*; even at present it unfortunately happens that but little of the information contained in that paper is known to, or understood by those to whom the treatment of the cases in question is usually trusted; perhaps for want of explicit directions as to the manner in which the discoveries alluded to were to be brought to bear upon practice; this was one of the main ends of those papers which the Royal Society has done me the honour to publish in their Transactions, (*Phil. Trans.* 1808, *&c.*) and the deficiency has since been made good in a more able and connected manner by the publication of Dr. Marcet's essay.

When a stone has once lodged in the bladder, and increased there to such a size as no longer to be capable of passing the urethra, it is, I believe, generally allowed by all those who have

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candidly considered the subject, and whose experience has made them judges of it, that that stone can never again be dissolved; and although it is possible that it may become so loosened in its texture as to be voided piece-meal and gradually to crumble away, the chances are so much against such an event, that it is scarcely to be ranked among probable occurrences.

In considering, then, the treatment of calculus of the bladder, our attempts are to be directed to the palliation of present symptoms, and to the prevention of increase of size of the stone. Opiates, and the warm bath, and other remedies of that description, may here be passed over, in order to consider the more abstract chemical treatment.

By the inspection of collections of calculi, we are taught that in by far the greater number of cases, a nucleus of uric acid is enveloped in a crust of the phosphates; our endeavours, therefore, must be directed towards reducing the quantity of uric acid in the urine to its natural standard, when in excess; and to diminishing, as far as may be, the tendency to the deposition of the phosphates, and (as is obvious from the account of the treatment of sand given above,) (Vol. VI. p. 195.,) two very different means being required to attain this end, the impropriety of applying one mode of treatment to all calculous cases becomes too evident to require any further refutation.

If, upon examination, it be found that the urine abounds in uric acid, and if, as is frequently the case, red sand is voided, magnesia and the alkalis may be resorted to, but they should not be persevered in beyond what is necessary to arrest the progress of the uric secretion; or if continued as preventives, they should be exhibited in small doses. It is here especially that magnesia proves useful, for it is less apt to occasion indigestion and its attendant symptoms, than any other alcaline medicine.

If the phosphates predominate, and if white sand is voided, the acids may be resorted to; but in consequence of the more irritable state of the parts, it becomes, more than ever, necessary, to use them with circumspection. In general, the white sand voided by patients suffering under stone of the bladder, is

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occasioned by the too free use of alkalis, and I have more than once known the white sand, thus *produced*, mistaken for the effect of the medicine upon the stone itself, which the patient was led to believe was in the process of solution or disintegration. It is in this way that the alkalis may do considerable mischief, by increasing the facility with which the urine deposits the phosphates upon the nucleus in the bladder, thus tending to the very rapid growth of the stone.

By minute attention to the history of a case, and by knowing the treatment that has been pursued, I have sometimes been able to foretel with some accuracy the nature and structure of the stone, before its removal by operation.

A patient who was cut for the stone in St. George's Hospital by Sir Everard Home, informed me that about ten years previous to his admission he had suffered pain in the right kidney, which continued for many months, and ended in voiding a quantity of gravel, which he had preserved, and which consisted of uric acid; his urine remained high coloured, and subject to a copious red deposit, and in about three months he became sensible of there being some extraneous body in the bladder, but was not sufficiently annoyed by it to adopt any medical treatment. Two years afterwards he had been exercising a restive horse, and on his return home was seized with all the symptoms of stone of the bladder; he voided for some days a much larger quantity of red sand than usual, and was directed to take soda water, solution of caustic potassa, and lime-water, which he persevered in almost constantly for two years and a half; he felt much relieved, had suffered no pain in the affected kidney, and only twice during the above period had been in much pain in the bladder. He had almost constantly voided white sand, which at last, during the use of the lime-water, became so copious as to induce him to *regard it as lime*, and consequently to leave off his medicines. About eighteen months previous to his admission into the hospital, a violent attack of pain came on in the kidney, and he voided between twenty and thirty small uric calculi with most excruciating pain. Uric acid now continued so obstinately prevalent, that large doses of the alkalis did not

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prevent the formation of red sand; his sufferings increased, and upon admission to the hospital he passed large quantities of uric and fusible sand mixed with ropy mucus.

The history of this case naturally led to the inference, that the stone would be found to consist of an uric nucleus enveloped in the phosphates, and upon making a section of it, (it was the size of a small hen's egg, somewhat flattened,) a kidney calculus of uric acid was perfectly distinct in its centre, surrounded by a less compact deposition of the same substance; exterior to this was a layer of the mixed phosphates, (fusible) and the outer crust was an intimate mixture of the phosphates and uric acid; so that these successive deposits presented a sufficiently distinct epitome of the case.

Other cases to the same point, and equally illustrative, are detailed in Sir Everard Home's observations on calculi, annexed to my paper, communicated to the Royal Society in 1808 (*Phil. Trans.* 1808.), and where uric acid and the phosphates only are concerned, it is in general not difficult, from a consideration of the history of the case, to predict the nature of the calculus.

Where the calculus is of oxalate of lime, or of cystic oxide, the prognostics are by no means so decided; in the former, it generally, I think, happens, that there is little or no sand or gravel voided, and that we hear of the symptoms of the stone of the bladder following those of the passage of a calculus along the ureter, but unattended by that production of uric acid and of the phosphates, which prevails in the former cases. I can only cite one instance of the extraction of a mulberry calculus by operation, in which some account of the previous symptoms was obtained. The man was 62 years of age, and about five years previously had suffered a slight attack of the symptoms of a stone passing from the kidney to the bladder; he had voided no sand, and his urine always appeared clear; during the last two years the symptoms of stone in the bladder attained such violence as to render the operation necessary, and a very perfectly-formed mulberry calculus, about the size of a nutmeg, with a distinct oxalate of lime nucleus was removed.

Of the history of cystic oxide, as relating to the present in-

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quiry, I know nothing beyond what has elsewhere been mentioned.

The idea of *dissolving* a calculus of uric acid in the bladder by the internal use of the caustic alkalis, appears too absurd to merit serious refutation; it is not possible that they should reach the bladder in a caustic state, in which state only they dissolve uric acid; and if they could arrive there, the mischief done to the urinary passages would doubtless be such as to render their use dangerous and impracticable; so far, therefore, from diminishing the bulk of a stone in the bladder by the solvent power of the alkalis, they will, if not administered and watched over with all caution, tend to increase its size by facilitating the deposition of the phosphates. At the same time it cannot be denied that the alkalis are very efficacious in preventing the increased secretion of uric acid; and when administered with that view, they may tend to prevent the increase of a calculus as far as uric acid is concerned, and in that way add to the chance of its being voided. How the alkalis act, is a question, the discussion of which would lead to an inquiry too extensive for my present purpose; but since magnesia, and carbonate of lime, which are difficultly soluble substances, are possessed of an influence over the secretion of uric acid, similar to that of the soluble alkalis, it would seem probable that this operation is chiefly carried on in the stomach and intestines, and that the circumstance of the alkalis and their carbonates passing off readily by the kidneys has not so much to do with their lithontriptic virtues, as has been often supposed.

In respect to the phosphates, it seems possible, that by keeping up an unnatural state of acidity in the urine, a crust of the calculus might so far be softened as to crumble down, or admit of being scratched by an instrument, but this is the utmost that can be looked for, and the uric nucleus remains a complete bar to any perfect removal.

These considerations, independent of more urgent reasons, show the futility of attempting the solution of a stone of the bladder by the injection of acid and alkaline solutions. In respect to the alkalis, if sufficiently strong to act upon the

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uric crust of the calculus, they would certainly injure the coats of the bladder; they would also become inactive by combination with the acids of the urine, and they would form a dangerous precipitate from the same cause. The acids, even when very largely diluted, and qualified with opium, always excite great irritation; they cannot, therefore, be applied strong enough to dissolve any appreciable portion of the stone, and the uric nucleus always remains as an ultimate obstacle to success. Of the greatest difficulty in this plan I have said nothing; namely, the ascertaining the nature of the surface of the stone that is to be acted upon; for admitting this to be known, the above objections and the necessity of the very frequent introduction of an instrument into the highly irritable bladder, are obstacles which I cannot regard as surmountable. It therefore appears to me, that Fourcroy, and others who have advised the plan of injection, have thought little of all these obstacles to success, and have regarded the bladder as a lifeless receptacle into which, as into an India rubber bottle, almost any solvent might be injected with impunity.

Having shewn the extreme improbability of even a small calculus being dissolved in the bladder, it only remains to notice those cases of supposed solution which have given celebrity to certain remedies; or, in other words, to mention those causes which tend to annihilate the ordinary symptoms of calculus, though the concretion still remains in the bladder.

Sir Everard Home, in his observations above quoted, has furnished some valuable illustrative cases on this head; and has particularly noticed two, "*because they were published during the patient's life-time, in proof of the stone being dissolved.*" These patients had both suffered from the disease many years, but when they attained the age of about 68, the symptoms entirely left them. In one of these cases twenty calculi were found in the bladder after death, and the cause of the disappearance of the symptoms was found in the enlargement of the posterior lobe of the prostate gland, which, forming a barrier between the calculi and the orifice of the bladder, kept the calculi in its lower posterior part, where they lay without producing disturb-

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ance. In the other patient there were fourteen calculi, under the same circumstances.

Another cause of the disappearance of symptoms, and probably not of unfrequent occurrence, is the lodgment of the stone between the muscular fasciculi of the bladder, where it becomes embedded in a pouch, and occasions no further inconvenience; and in both these cases a further source of deception may arise in the stone not being readily discoverable by a sound. (See a Plate in Dr. Marcet's *Essay*.)

Lastly, the symptoms of stone have in some few instances almost entirely vanished without any apparent cause; and in two cases that have come within my own knowledge, calculi have been found after death, the existence of which was not suspected during the life of the patient.

I cannot better close these remarks, than by again insisting, both from the patient and practitioner, upon the strictest attention to the earliest stages of the disease, when, in the majority of instances, it is in a manageable state; and by urging that attention to the nature of the urinary secretions, and to the causes which modify them, upon which alone effectual preventive means can be founded; and by recalling to mind the very important aid that is to be derived from general treatment, connected with the diet, the exercise, and the mode of life of the patient.

Little is known respecting the comparative prevalence of calculous disorders in different districts and countries; and, as will be seen by reference to Dr. Marcet's chapter on this subject, the means of information are very imperfect. We may, I think, rest satisfied that peculiarities in the water of different places have no influence upon the production of calculous disorders, nor does the evidence appear conclusive respecting their supposed prevalence in cider countries: upon these subjects, however, it is extremely difficult to gain unobjectionable information. It is to be hoped that the usefulness of preserving calculi, with the history of their cases annexed, will induce private individuals to contribute their specimens to some public collection, that of the College of Surgeons, for instance; where they

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should not merely be preserved as curiosities in a glass case, but a proper section should be made of them, and a note of their chemical composition, together with the sources whence they were obtained, annexed to each calculus. In this way, in the course of a few years, a collection would inevitably arise invaluable both to the master and pupil, and tending more than any other method to elucidate the history of calculous disorders*.

Among the important facts brought to light by Dr. Wollaston's researches, is the analogy between urinary and gouty concretions, the latter consisting of uric acid in combination with soda. Another circumstance, showing the relation subsisting between gout and gravel, is the frequent alternation of the two series of symptoms, and the abundant deposition of uric sand that often announces the departure of an attack of gout.

The same causes which produce gout are probably often effective, as I have elsewhere stated, in disposing to calculous affections, and the same remedies are often efficacious in both diseases. It deserves trial, how far the Colchicum Autumnale, which has proved a specific in gout, may be efficacious in preventing the formation of that excess of uric acid in the system, which, when thrown off by the kidneys, forms the commonest kind of gravel and calculus, and that which is productive of the most alarming consequences †.

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* This plan is pursued, I understand, in the Norwich and Norfolk Infirmary, with the greatest advantage.

† Since writing the above, I have received a very flattering account of the success that has attended the use of the *Viscum Quercus* in an obstinate case of red gravel, but have not been able to obtain such particulars as can at present be published. I trust the subject will not escape the attention of those whose practice may enable them further to investigate it.

I take this opportunity of referring the reader to a valuable paper of Dr. Henry on Urinary Concretions, in the tenth volume of the *Medico-Chirurgical Transactions*. I was not acquainted with this paper whilst writing the above, or I should have availed myself of its contents. I am happy to find many of my conclusions sanctioned by Dr. Henry's authority.

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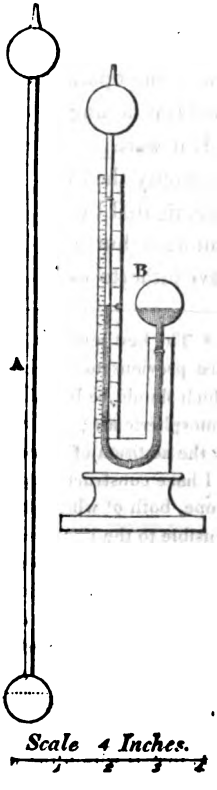
Art. II. *Description of a Differential Thermometer.* By W. Howard, M.D.

This instrument is an imitation of Mr. Leslie's differential thermometer, but is on a different principle. In his, the degree of heat is measured by the expansion of air, but in the present one by the increase of expansive force of the vapour of ether or spirit of wine *in vacuo*, which affords a test of great delicacy, and is easily constructed.

A tube (A) being first made with a ball at each extremity, in one of which is left a small orifice, a portion of ether or spirit of wine is then introduced, and heat being applied, is brought to a state of active ebullition. At this moment the orifice is closed with a piece of wax, and finally hermetically sealed by the blow-pipe. The tube may then be carefully bent in the form of a hook, and the scale and foot being adapted, the instrument is finished. (B).



This thermometer is intended to be used in the same cases as that of Mr. Leslie, but I conceive it to possess some advantages. It is more delicate. When a heated body, as the hand, is approached to one of the balls, the liquid sensibly ascends or descends, and as soon as this cause is removed, begins instantly to return to its former level. Whereas in the air thermometer, the impulsion to the liquid is not instantaneous, and it continues to move in the same direction a moment after the heating cause is removed.

If the two balls were freed entirely from air, the liquid would always remain at the same level in each branch of the tube, except a trifling difference caused by capillary attraction. This

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perfection cannot be obtained by the most skilful artist; there always remains behind, notwithstanding all care to prevent it, a small residuum of air, which is sufficient to make a difference in the height of the two columns. To obviate this inconvenience, before the scale is adapted, the liquid is all to be brought into one ball, and the instrument is then reversed and left for a considerable time in that position, that both balls may acquire an equal temperature, and the small portion of air may be equally diffused through them. It is then to be restored to its proper position, and the point at which the liquid finally settles, is to be marked as the commencement of the scale. The same operation is to be repeated whenever the instrument has been deranged by transportation or other causes.

If it were possible to employ constantly ether or spirit of wine of exactly the same degree of strength, it is plain from the laws investigated by Mr. Dalton, that the scale would be constantly uniform; but as this is not easily obtained it is arbitrary. I have hitherto used the division of the millimetre of France *.

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* The best mode of constructing the above instrument, is to bend the tube previous to the introduction of the ether, a considerable portion of which should be boiled out of the tube, in order to ensure the expulsion of atmospheric air; it is also convenient to tinge the ether of a red colour, by the addition of a drop of tincture of cochineal.

I have constructed upon the same principle a photometer, and an ethrioscope, both of which, though liable to some objections, are most curiously sensible to the impression of light, and to the frigorific emanations of the heavens. I have also employed a modification of the same instrument as a photometric thermometer, which I have found useful in comparative experiments upon the light of different flames. For this purpose, the instrument is constructed as shewn in the above wood-cut, by Dr. Howard; the upper ball is then covered by a thin coating of Indian ink, and the other with gold leaf, applied by a dilute spirit-varnish; it is then covered by a thin glass shade. Upon bringing a candle near the black, or sentient, ball, that is within the distance of 14 inches, or one foot, it produces an instantaneous depression of the column of liquid. Placing this instrument at the distance of 16 inches from the flame of a wax candle, it fell 1° in 1′. A gas flame which I had previously ascertained, by a comparison of shadows, to give the light of eight wax candles, caused a depression of 10° in 1′, when placed at the same distance from the instrument.

W. T. B.

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Art. III. *Select Orchideæ from the Cape of Good Hope. Continued from page 44 of Vol. VI.*

Of Satyrium *bracteatum*, Pterygodium *alatum*, Corycium *orobanchoides*.

Note. Vol. 6. p. 44. l. 17. for "Disperis," *read* "Disa."

Plate III. *Fig.* 1. Satyrium bracteatum.

Satyrium. *Corolla* ringent; *petals* five front-ones connate at the base. *Label* at the back of the corolla, vaulted, with a double spur or a double pouch at the base. *Anther* reversed. *Stigma* two-lipped. Obs. a genus remarkable among its nearer co-ordinates for having the true *label* at the back of the flower; for Swartz, as Mr. Brown has shewn, in his *Prodromus of the Flora of New Holland*, was wrong in supposing the middle front petal to be the label in this genus.

Satyrium *bracteatum*, leaves ovate, three-nerved, bractea ovate, reflexed, spurs very short and obtuse.

Satyrium bracteatum. *Thunb. Prod.* 6. *Flor. Cap.* 1. 93. *Swartz in Act. Holm.* 1800. 216. *Idem in Schräder's Neues Journal*, 1. 35. *Willdenow Sp. Pl.* 4. 56.

Ophrys bracteata. *Linn. Suppl.* 403.

Root with roundish tubers. *Stem* about a span high. *Radical leaves* ovate, nerved; *stem ones* ovately oblong, several. *Spike* many-flowered, close; *bractes* ovate, spreading, longer than the flowers. *Label* roundish. *Lower lip* of the corolla, 3-lobed.

Plate III. *Fig.* 2. Pterygodium alatum.

Pterygodium *alatum*; stem leafy, leaves lanceolate, label three-cleft, middle segment very short.

Pterygodium alatum. *Swartz in Act. Holm.* 1800. *p.* 218. *Idem in Schräder's Neues Journal, v.* 1. 37. *Willd. Sp. Pl.* 4. 56. *Thunb. Flor. Cap.* 1. 114.

Ophrys alata. *Thunb. Prod.* 2. *Linn. Suppl.* 404.

A small plant.

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Plate III. *Fig.* 3. CORYCIUM OROBANCHOIDES.

CORYCIUM *orobanchoides*, leaves linear, distichous, casque with a double spur.

Corycium orobanchoides. *Swartz in Act. Holm.* 1800. p. 222. *Idem in Schräder's Neues Journal, v.* 1. 43. *Willd. Sp. Pl.* 4. 60. *Thunb. Flor. Cap.* 1. 99.

Satyrium orobanchoides. *Thunb. Prod.* 6. *Linn. Suppl.* 402.

None of the above three species have ever been represented by any figure, previous to those now published; nor does any plant of them appear to have been introduced into any European garden. Dried samples of all of them are contained in the Banksian Herbarium.

ART. IV. *A Letter on the Antiquities of the Western Parts of the State of New-York, addressed to the* Honourable SAMUEL L. MITCHILL, *a Vice President of the Literary and Philosophical Society of New-York, Professor of Natural History in the University of the State, &c. &c. Communicated by* SIR GILBERT BLANE, Bart.

[AS the progress of cultivation extinguishes the remains of antiquities mentioned in this memoir, the view of the writer, in publishing it, is to awaken inquiry to a subject of great importance, before the means of investigation are entirely lost.]

SIR,

BACON describes antiquities, "history defaced, or some remnants of history which have casually escaped the shipwreck of time, *tanquam tabula naufragii*, when industrious persons, by exact and scrupulous diligence and observation, out of monuments, names, words, proverbs, traditions, private records and evidences, fragments of stories, passages of books that concern not story, and the like, do save and recover somewhat from the deluge of time." The antiquities of our country have always appeared to me more important and to deserve more attention than they have heretofore received. We have indeed no written authorities or documents to recur to, except the ancient French and

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Dutch writers; and it is well known that their attention was almost solely absorbed in the pursuit of wealth, or in the propagation of religion, and that their sentiments were shaped by reigning prejudices, regulated by pre-conceived theories, controlled by the policy of their sovereigns, and obscured by the darkness which then covered the world.

To rely entirely on the traditions of the Aborigines for authentic or extensive information, is to lean on a broken reed. Those who have interrogated them must know that they were generally as ignorant as the inquirer; that the ideas they communicated, were either invented at the moment, or were so connected with palpable fable as to be almost entirely unworthy of credit. Having no written auxiliaries to memory, the facts with which they were acquainted, became, in process of time, obliterated from the mind or distorted by new impressions and new traditions. If, in the course of thirty years, the Buccaneers of St. Domingo lost almost every trace of Christianity, what confidence can we repose in the oral history delivered to us by savages without the use of letters, and continually engrossed in war or in the chase?

The field of inquiry is then limited in its range, but happily it is not entirely closed against us. The monuments which remain, afford considerable room for investigation. The languages, the persons, and the customs of the red men may be made use of to illustrate their origin and history; and even the geology of the country, may in some cases, be successfully applied to shed light on the subjects of inquiry.

Having had some opportunities for personal observation and not a few for inquiry, I am induced to believe that the western parts of the United States were, prior to their discovery and occupation by Europeans, inhabited by numerous nations in a settled state, and much further advanced in civilization than the present tribes of Indians. Perhaps it is not too much to say, that they did not fall far short of the Mexicans and Peruvians when first visited by the Spaniards. In my illustrations of this subject, I shall principally confine myself to this state, occasionally glancing beyond it, and avoiding, as far as possible, topics which have been heretofore discussed.

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The town of Pompey, in the county of Onondaga, is the highest ground of that country, and divides the waters which flow into the bay of Chesapeake and the gulf of St. Lawrence. The most elevated parts of the town exhibit the remains of ancient settlements, and in various other parts of it, the vestiges of a numerous population appear. About two miles south from Manlius square, and in the town of Pompey, I examined the remains of a large town, which were obviously indicated by large spots of black mould in regular intervals of a few paces distant, in which I observed bones of animals, ashes, carbonized beans or grains of Indian corn, denoting the residence of human beings. This town must have extended at least half a mile from east to west, and three quarters of a mile from north to south. This extent I could determine with considerable accuracy from my own view, but I was assured by a gentleman of veracity, that its length from east to west was one mile. A town covering upwards of five hundred acres must have contained a population greatly transcending all our ideas of credibility. A mile to the east of the settlement there is a burying-ground containing three or four acres, and close to the west end there is another. This town was on elevated ground, about twelve miles distant from the Salt Springs of Onondaga, and was well calculated for defence. On the east side, there is a perpendicular descent of one hundred feet into a deep ravine, through which a fine stream flows, and on the north side, a similar one. There are three old forts distant about eight miles from each other, and forming a triangle which encloses the town; one a mile south of the present village of Jamesville, and the other north-east and south-east in Pompey; and they were, in all probability, erected to cover the town and to protect the inhabitants against the attacks of an enemy. All these forts are of a circular or elliptical form; there are bones scattered all over the ground; an ash tree growing on it was cut down, and the concentric circles showed it to be ninety-three years old. On a heap of mouldered ashes, composing the site of a large house, I saw a white pine tree, eight and a half feet in circumference, and at least one hundred and thirty years old. On the line of the north side, the town was

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probably stormed. There are graves on each side close to the precipice; sometimes five or six persons were thrown promiscuously into the same grave. If the invaders had been repulsed, the inhabitants would have interred the killed in the usual places, but, from the circumstance of there being graves near the ravine and in the village, I am induced to believe that the town was taken. On the south side of this ravine, a gun-barrel, several bullets, a piece of lead, and a skull perforated by a ball, were discovered. Indeed, gun-barrels, axes, hoes, and swords are found all over these grounds, and I procured the following articles which I now transmit to the society to be deposited in their collection: two mutilated gun-barrels, two axes, a hoe, a bell without a clapper, a piece of a large bell, a finger ring, a sword blade, pieces of bayonets, gun locks and earthen ware, a pipe, door latch, beads, and several other small things. These demonstrate European intercourse, and from the attempts which were evidently made to render the gun-barrels useless by filing them, there can be little doubt but that the Europeans who had settled here, were defeated and driven from the country by the Indians.

Near the remains of this town, I observed a large forest which was in former times cleared and under cultivation; and I drew this inference from the following circumstances: There were no hillocks or small mounds, which are always the result of uprooted trees; no uprooted or decaying trees or stumps, no underwood, and the trees were generally fifty or sixty years old. Many, very many, years must elapse before a cultivated country is covered with wood. The seeds must be slowly conveyed by winds and birds. The town of Pompey abounds with forests of a similar character; some are four miles long and two wide, and it contains a great number of ancient places of interment; I have heard them estimated at eighty. If the present white population of that country were entirely swept away, perhaps in the revolution of ages similar appearances would exist.

It appears to me that there are two distinct eras in our antiquities; one applicable to the remains of old fortifications and settlements which existed anterior to European intercourse,

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and the other referring to European establishments and operations; and as the whites as well as the Indians would frequently resort to the former for protection, habitation, or hunting, they must necessarily contain any articles of European manufacture, and thereby great confusion has resulted by blending together distant eras greatly remote in point of time.

The French had, undoubtedly, large establishments in the territory of the Six Nations. A quarto volume in Latin, written by Francis Creuxiues, a Jesuit, was published at Paris in 1664, and is entitled "*Historiæ Canadensis seu Novæ Franciæ Libri decem ad annum usque Christi*, MDCLVI." It states that a French colony was established in the Onondaga territory about the year 1655; and it thus describes that highly fertile and uncommonly interesting country. "Ergo biduo post ingenti agmine deductus est ad locum gallorum sedi atque domicilio destinatum, leucas quatuor dissitum a pago, ubi primum pedem fixerat, vix quidquam a natura videre sit absolutius: ac si ars, ut in Gallia, ceteraque Europa, accederet, haud temere certaret cum Baijs, Pratum ingens cingit undique silva cœdua ad ripam Lacus Gannentaæ, quo Nationes quatuor, principes Iroquiæ totius regionis tanquam ad centrum navigolis confluere perfacile queant, et unde vicissim facillimus aditus sit ad eorum singulas, per amnes lacusque circumfluentes. Ferinæ copia certat cum copia piscium, atque ut ne desit quidquam, turtures eo undique sub veris initium convolant, tanto numero, ut reti capiantur. Piscium quidem certe volant, ut piscatores esse ferantur qui intra unius noctis spatium anguillas ad mille singuli, hamo capiant.—Pratum intersecant fontes duo, centum prope passus alter ab altero dissiti: alterius aqua salsa salis optimi copium subministrat, alterius lympha dulcis ad potionem est; et quod mirere, uterque ex uno eodemque colle scaturit." It appears from Charlevoix's *History of New France*, that missionaries were sent to Onondaga in 1654; that they built a Chapel and made a settlement; that a French colony was established there under the auspices of Le Sieur Dupuys in 1656, and retired in 1658; and that the missionaries finally abandoned the country in 1668. When La Salle started from Canada and went down the Missis-

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sippi in 1679, he discovered a large plain between the lake of the Hurons and that of the Illinois, in which was a fine settlement belonging to the Jesuits.

The traditions of the Indians agree in some measure with the French relations. They represent that their forefathers had several bloody battles with the French, and finally compelled them to abandon the country; that the French, after being driven to their last fortress, capitulated and agreed to depart on being furnished with provisions; that the Indians filled their bags with ashes covered with corn, and that the greater part of the French in consequence fell victims to famine at a place called by them, Anse de Famine, and by us, Hungry Bay, on lake Ontario. There is a hill in Pompey, which the Indians will not visit, and which they call Bloody Hill. It is surprising that no old Indian weapons, such as stone-knives, axes, and arrow-heads are found in this country. It appears that they were superseded by French substitutes of iron.

The old fortifications were erected previous to European intercourse. The Indians are ignorant by whom they were made; and in the wars which took place in this country, it is probable that they were occupied as strong holds by the belligerents; and it is likely that the ruins of European works of a different construction may be found in the same way that Roman and British fortifications are to be seen in the vicinity of each other in Great Britain. It is remarkable that our ancient forts resemble the old British and Danish. Pennant, in his *Tour in Scotland* says, "On the hill, near a certain spot, is a circular British intrenchment, and I was told of others of a square form at a few miles' distance, I suppose Roman;" and in his *Tour through Wales*, he describes "a strong British post on the summit of a hill in Wales, of a circular form, with a great foss and dike, and a small artificial mount within the precinct." How exactly does this correspond with our old forts. The Danes, as well as the nations which erected our fortifications, were, in all probability of Scythian origin. According to Pliny, the name of Scythian was common to all the nations living in the north of Asia and Europe.

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In the town of Camillus, in the same county of Onondaga, about four miles from the Seneca River, thirty miles from lake Ontario, and eighteen from Salina, there are two ancient forts on the land of Judge Manro, who has been settled there about nineteen years. One is on a very high hill, and its area covers about three acres. It had one eastern gate, and in the west there was another, communicating with a spring about ten rods from the fort; its shape, elliptical. The ditch was deep, and the eastern wall ten feet high. In the centre was a large limestone, of an irregular shape, which could be raised by two men; the bottom was flat, and three feet long. It contained, in the opinion of Judge Manro, unknown characters, plainly figured on the stone, to the extent of eighteen inches in length and three inches in breadth. When I visited this place, the stone was not to be seen, and my inquiries to find it were unsuccessful. I saw the stump of a black oak on the wall, one hundred years old; and about nineteen years ago there were indicia of two preceding growths. The second fort is almost half a mile distant, on lower ground, constructed like the other, and is about half as large. Near the large fort, there are the marks of an old road now covered by trees. I also saw, in several places in this town, on high ground, considerable ridges stretching from the top to the bottom of the hills, and the gullies between of no great width. This phenomenon occurs in very ancient settlements, where the soil is loamy and the hills steep, and it is occasioned by crevices produced and gradually enlarged by torrents. In a forest state this effect cannot result; and this evinces that those grounds were cleared in ancient times. When settled by us, they exhibited the same appearance as now, except being covered by wood; and as stumps are now to be seen in the gullies, the ridges and intervening small ravines could not have been made by the last clearing. The first settlers observed shells of testaceous animals accumulated in great masses in different places, and numerous fragments of pottery. Judge Manro found, in digging the cellar of his house, several pieces of brick. In various places, there were large spots of deep black mould, demonstrating the former existence of buildings and erections of differ-

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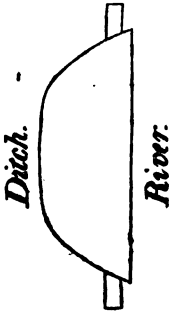
ent kinds; and Judge Manro, seeing the appearance of a well, *viz.*, a hole ten feet deep and the earth considerably caved in, he dug three and a half feet deep, and came to a parcel of flints, below which he found a great quantity of human bones, which pulverized on exposure to the air. This is strong evidence of the destruction of an ancient settlement. The disposal of the dead was unquestionably made by an invading enemy.

I also observed, on Boughton's hill, in Ontario county, where a bloody battle is said to have been fought, black spots of mould at regular intervals, and yellow clay between. The most easterly fortification yet discovered in this region, is about eighteen miles east of Manlius Square, with the exception of the one in Oxford, Chenango county, hereafter mentioned. To the north they have been discovered as far as Sandy Creek, about fourteen miles from Sacket's Harbour; near that place there is one that covers fifty acres, and that contains numerous fragments of pottery. To the west there are great numbers. There is a large one in the town of Onondaga, one in Scipio, two near Auburn, three near Canandaigua, and several between Seneca and Cayuga lakes, there being three within a few miles of each other.

The fort before referred to, as being in Oxford, is on the east bank of the Chenango river, in the centre of the present village, which is on both sides of the river. There is a piece of land containing between two and three acres, which is about thirty feet higher than the adjoining flat lands round it. This rise of land lies along the river bank about fifty rods, and at the south-westerly end this fort was situated. It contained about three roods of ground, and on the river the line was nearly straight, and the bank almost perpendicular. The figure nearly like the annexed wood-cut.



At the places north and south, marked for gates, there were two spaces of about ten feet each where the ground has not been

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broken, which were, undoubtedly the entrances or gateways by which the people of the fort went out and in, and particularly for water. The curve, except the gateways, was a ditch regularly dug; and although the ground on which the fort is situated, was, at the first white settlement, as heavily timbered as any other part of the forest, yet the lines of the work could be distinctly traced among the trees, at the distance from the bottom of the ditch to the top of the embankment, generally, of about four feet. The antiquity of this fortification is more particularly evident from the following fact. There was one large pine tree or rather dead trunk, fifty or sixty feet high, which being cut, one hundred and ninety-five circles of the wood could be easily distinguished, and many more could not be counted, as the sap wood of the tree was principally gone. Probably this tree was three or four hundred years old: certainly more than two hundred. It might have stood one hundred years after it had completed its growth, and even longer. It is also uncertain how long a time elapsed from the excavation of the ditch to the commencement of the growth of this tree. That it was not there when the earth was thrown up, is certain; for it stood on the top of the bank, and its roots had shaped themselves to the ditch, running quite under the bottom of it, then rising on the other side near the surface of the earth, and then pursuing a horizontal direction. Probably this work was picketed in, but no remains of any wooden work have been discovered. The situation was very eligible, being healthy, commanding a beautiful prospect up and down the river, and there being no highland within such a distance that the garrison could be annoyed. No vestiges of any implements or utensils have been found, except some pieces of coarse pottery resembling stone ware and roughly ornamented. The Indians have a tradition that the family of the Antones, which is supposed to belong to the Tuscarora nation, are the seventh generation from the inhabitants of this fort; but of its origin they know nothing. There is also a place at Norwich, in the same county, on a high bank of the river, called the castle, where the Indians lived at the period of our settling the country, and some vestiges of a fortification appear

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there, but it is, in all probability, of a much more modern date than the one at Oxford.

In the town of Ridgeway, in Genessee county, there have been discovered several ancient fortifications and burying-places. About six miles from the Ridge road, and south of the great slope or mountain ridge, an old burying ground has been discovered within two or three months, in which are deposited bones of an unusual length and size. Over this ground lay the trunk of a chesnut tree, apparently four feet through at the stump; the top and limbs of this tree had entirely mouldered away by age. The bones lay across each other in a promiscuous manner; from which circumstance, and the appearance of a fort in the neighbourhood, it is supposed that they were deposited there by their conquerors; and from the fort being situated in a swamp, it is believed it was the last resort of the vanquished, and probably the swamp was under water at the time.

There are extensive clearings in the Indian reservation at Buffalo, of which the Senecas can give no account. Their principal settlements were at a great distance to the east, until the sale of the greater part of their country since the conclusion of the revolutionary war.

On the south side of lake Erie, there is a series of old fortifications, running from the Catteragus creek to the Pennsylvania line, a distance of fifty miles; some are two, three, and four miles apart, and some within half a mile. Some contain five acres. The walls, or breastworks, are of earth; and they are generally on ground where there are appearances of creeks having once emptied into the lakes, or where there was once a bay; so that it is inferred that these works were once on the margin of lake Erie, which has now retreated from two to five miles northerly. Still further south, there is said to be another chain of forts running parallel with the former, and about the same distance from them as those are from the lake. The country here exhibits two different tables or sections of bottom, intervale, or alluvial land; the one nearest the lake being the lower, and, if I may so denominate it, the secondary table land: the primary or more elevated table land is bounded on the south by hills and

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valleys where nature exhibits her usual aspects. The primary alluvial land was formed from the first retreat or recession of the lake, and then, it is supposed, the most southern line of fortifications was erected. In process of time, the lake receded further to the north, leaving another section of table land on which the other tier of works was made. The soil on the two flats is very different; the inferior being adapted for grass, and the superior for grain, and the timber varies in a correspondent manner. On the south side of lake Ontario, there are also two alluvial formations; the most recent is north of the ridge road; no forts have been discovered on it. Whether there be any on the primary table land, I have not learnt; south of the mountain ridge many have been observed.

In the geology of our country, it is important to remark, that the two alluvial formations before mentioned, are, generally speaking, characteristic of all the lands bordering on the western waters. While, on the eastern waters, there is but one alluvial tract, with some few exceptions. This may be ascribed to the distance of the St. Lawrence and the Mississippi from the ocean, their having prostrated, at two different periods, impediments or barriers, and in consequence of thus lowering the beds in which they flowed, having produced a partial exhaustion of the remote waters. These distinct formations may be considered as great chronological landmarks. The non-existence of forts on the secondary or primary alluvial formations of lake Ontario is a strong circumstance from which the remote antiquity of those on the highlands to the south may be deduced; because if they had been erected after the first or last retreat of the lake, they would undoubtedly have been made on them as most convenient and best adapted for all military, civil, and domestic purposes.

The Iroquois formerly lived, according to their traditions, on the north side of the lakes. When they migrated to their present country, they extirpated the people who occupied it; and after the European settlement of America, the confederates destroyed the Eries or Cat Indians, who lived on the south side of lake Erie. Whether the nations, which possessed our western country before the Iroquois, had erected those fortifications to

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protect them against their invaders, or whether they were made by anterior inhabitants, are mysteries which cannot be penetrated by human sagacity; nor can I pretend to decide whether the Eries or their predecessors raised the works of defence in their territory; but I am persuaded that enough has been said to demonstrate the existence of a vast population, settled in towns, defended by forts, cultivating agriculture, and more advanced in civilization than the nations which have inhabited the same countries since the European discovery.

ART. V. *Account of a Portable Gas Lamp.*

SIR, *London, Nov.* 1, 1819.

IN the second Number of the *Edinburgh Philosophical Journal*, I observe an account of what is termed a *new* portable gas-lamp, invented by David Gordon, esq., of Edinburgh. We are further informed that Mr. Gordon has secured, by patent, the exclusive privilege of this invention. May I beg leave to ask, whether, in the Spring of 1817, you did not exhibit a similar contrivance in your lectures at the Royal Institution, with the observation that, "the size of the lamp, the difficulty of filling it with condensed gas, and its great liability to leak, were only a few of the obstacles to its useful application and adoption."

Your obedient Servant,

"Professor Brande, M. R. I.
Royal Institution."

IN answer to the above, I subjoin a short account of the lamp in question, which is represented in the annexed wood cut; and which, as appears from Mr. Newman's books, was made by him for the Royal Institution at my request, in May, 1816.

December, 1819. W. T. B.

The lamp consists of a hollow glass globe of adequate thickness, and surmounted by a stopcock and burner, resting upon,

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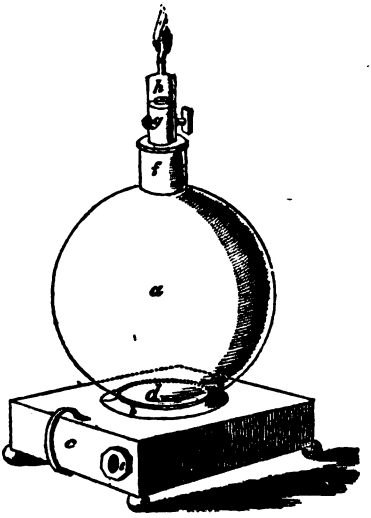
and communicating with, a square hollow pedestal of sheet copper.



a The glass globe fitted with a brass cap at *b*, firmly screwed into the copper box *c*, and communicating with it at the aperture *d*; *e* is a screw-hole supplied with a valve opening inwards, to which the condensing syringe is attached for the purpose of forcing in the carburetted hydrogen; *f* is a brass cap surmounted by the stopcock *g*, of very small bore, opening into the chamber *h*, to which the burners are attached.

Art. VI. *On the Manufacture of British Opium. By the Rev.* G. Swayne.

From the frequent paragraphs which have lately appeared in the public prints on the subject of opium, it should seem that the eyes of the British public are at length beginning to open to the prospect of those advantages which would be likely to accrue to the community, from the introduction of an article of commerce, so much wanted at home, to super-

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sede the abominably adulterated drug with which the guardians of our health are supplied from the Levant, &c., under that name; and so much in demand abroad, that the last advices from India inform us, that whilst trade in almost all other articles was in an unusually depressed state, the price of opium had risen from 20 to 25 rupees per chest. The introduction, therefore, of the plant which produces the article in question, into the agriculture of this country, discouraged as it is in the production of grain, by the existing system of corn-laws, assumes an interesting and important aspect.

In a late Number of the *Edinburgh Journal*, a new method is announced of collecting the milky juice of the poppy, from the plausibility of which it is not improbable that several persons in the United Kingdom may be induced to undertake this business. As the specimen of opium which Mr. Professor Brande was so good, upon my request, to submit to the trials of some medical friends last winter, was reported to be excellent, having had the experience of another season, added to that of several former years, to confirm the complete efficiency of the method and apparatus by which that specimen was obtained, I am now ready to communicate the same to the public through the medium of the *London Journal of Science and the Arts;* and I the rather wish them to be published some time this winter, that those persons who may be induced to engage in the preparation of opium in the ensuing season, from the account which has appeared in the *Edinburgh Journal*, supposing eventually they may not be satisfied with the method there recommended, may not give up the project in despair; but may have it in their power to make trial of another method, which with me has proved perfectly successful and satisfactory. By means of the method and apparatus above alluded to, half an ounce of liquid opium may generally be collected by *one* person in less than the space of an hour. And I have it upon record, that on one particular day in the year 1818, a single individual, considerably more than 70 years of age, collected no less than five ounces and a quarter of this fluid within five hours.

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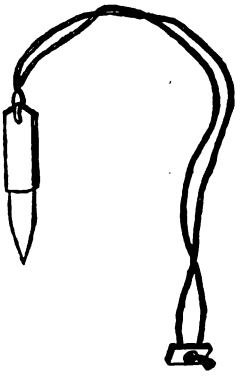
The apparatus consists of,



1. A scarifier, or lancet-blade, of a larger size than that used in surgery for venesection, about two inches and $\frac{3}{8}$ths in length, and $\frac{3}{16}$ths of an inch in breadth, with a rivet-hole at the blunt end, through which is inserted a strongly-twisted cotton string; the ends of which having been previously drawn through a small slit in a bit of leather intended as a slide, are to be tied in a firm knot, at a length sufficient, when slung on the right wrist, and confined to it by the slide, for the blunt end of the lancet-blade to reach the tops of the thumb, and first and second fingers, when united. This blade, if covered with thin leather, excepting about one inch from the point, will be softer and more commodious to the fingers.

2. A small pocket with strings, to be tied round the waist, eight inches wide, ten inches long in the back part, and about five in the fore-part, having two straps of cloth (or leather, which is preferable), five inches in length, and 1¼ inch in breadth, stitched on its back part in a longitudinal direction, 1¼ inch apart, for the purpose of forming sheaths to receive the arms of the bracket, to be hereafter described. The ends of the straps to stand ¼ of an inch above the back of the pocket. The use of this pocket is to hold any small matters which may be necessary.

3. Two goose-quills of the larger size, cut in the form of scoops; for the purpose of taking off the milky juice from the wounded capsules.

4. A tin cup, or receiver, 2¼ inches in diameter, and two inches deep, with cover to fit close, in the manner of a saucepan. In the centre of the cover, a circular hole is cut out 1¼ inch in diameter, into which is soldered a tin tube made to fit the same, 2¼ inches in length, standing 1¼ inch above the cover, and entering the cup below ¼ of an inch. A circular wire is soldered on round the cup on the outside, to form a groove for the ring of

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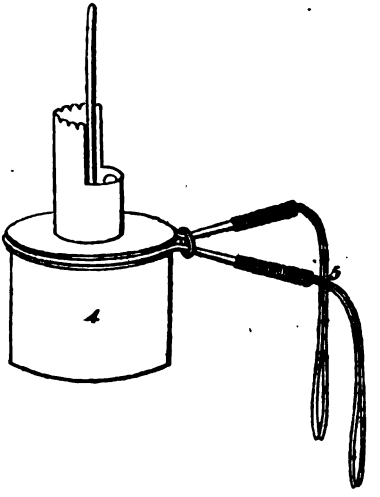
the bracket, which is to support it. A piece of tin is cut out from the upper part of the tube, a little more than $\frac{1}{3}$ of its circumference, and $\frac{1}{4}$ of an inch deep, which of course, renders $\frac{2}{3}$ of the upper part of the tube higher by $\frac{1}{4}$ of an inch than the remaining $\frac{1}{3}$. The edge of the higher part is then (to use the heraldic term) *invected*, that is, cut into a continuation of small convexities, of a size to fit the concavity of the scoop, or quill; so that when the latter is drawn across the edge to discharge its contents, its concavity may be sure to fall upon one of the convexities, and thus be scraped out clean. In the inside of the lower part of the tube, are soldered two small sockets, of a size to admit the pointed ends of the quills, but not suffer them wholly to pass through.



5. A bracket for supporting the tin cup, made of a piece of iron wire about $\frac{1}{12}$ of an inch in diameter, and 2 feet 9$\frac{1}{4}$ inches in length. The middle part of this piece of wire is bent close round the tin cup, in the groove formed by the circular wire abovementioned, so as to encircle the whole of the cup, excepting about $\frac{1}{4}$ of an inch, where the wire is again bent back on each side, horizontally, in angles of about 62$\frac{1}{2}$ degrees; at which angles it is confined close to the cup, by a hook of the same

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kind of wire, forming a ring round the top of the cup. The wire is then bent double, at six inches from each extremity, and both extremities secured by coiling some small brass wire round, for the length of about 1¼ inch, which last is of course to be properly fastened. The united wires are then to be bent perpendicularly downwards, in right angles, at 3¾ inches from their extremities, and the bracket is then finished.

The utility of this last contrivance does not consist merely in supporting the receiver, and keeping it firm and steady in one place (for which purposes neither of the hands could be applied, being both otherwise employed); but more especially in bringing it forwards in advance from the body, to meet the collecting implement, and into a situation to be more readily and easily observed by the eyes of the collector.

The expense of the whole of this apparatus, if purchased on wholesale terms, would not probably exceed eighteen pence or two shillings.

As soon as the forwardest poppies have their capsules about 1¼ inch in diameter (of which size they will generally be in about five or six days after the fall of the petals), accoutred with the above described apparatus, (the pocket tied round the waist; the tin cup encircled in the ring of the bracket, with its cover on; the invected part turned to the right hand, and the quills in their sockets; the arms of the bracket inserted in their sheaths, at the back of the pocket; and the lancet-blade slung on the wrist of the right hand, with the slide drawn up to the wrist), the operator begins his work.

He first, with the thumb of the left hand placed on the summit, or crown, and with the first and second fingers underneath, gently lays hold of a capsule; and with the lancet-blade held between the fingers and thumb of his right hand, makes a slight incision horizontally, about a quarter of an inch below the upper part of the bulb of the capsule, about an inch in length, taking care just to penetrate through the cuticle *into* the *cellular tissue*, (but not *through* it into the hollow part of the capsule, which would prove of bad consequence); he then as speedily as possible makes a second incision in the same direction, one fourth of an

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inch below the first, and a third at the same distance below the second. He then lets go the wounded capsule, and proceeds to a second, third, and so on, till he observes the milky fluid on the first nearly ready to drop; when he is to return to that, and to lay hold of it with the left hand in the same manner as at first; at the same time dropping the lancet-blade from the right hand, he takes one of the quills out of its socket, and with it begins scraping up the juice which has exuded, observing always, whilst doing this, to keep the point of the scoop *upwards*. From the first he is to proceed to the other wounded capsules in succession. After having scraped the whole of these, he is to return the quill into its socket; to resume the lancet-blade, by hanging down his right arm in a perpendicular direction (whereby he will instantly feel the instrument in his fingers), and proceed in scarifying. Whilst using the scoop, he is frequently to draw it across the invected edge of the tube, in order to relieve it from the juice collected therein; and whenever he observes the bole, or hollow part of it, to be nearly full, he is immediately to turn it down into its socket, that it may empty itself whilst he is using the other.

When the day's work is ended, the juice collected in the receiver is to be discharged into a deep earthenware plate, the cup scraped out clean with a table-knife appropriated to this use, and the quills well cleansed by means of each other. The plate is to be placed in some dry out-house (for its strong scent will scarcely allow it to be admitted into a dwelling-house), with a paper cover to prevent dust, &c., from mixing with its contents; and when a mass is accumulated therein, sufficient to make a loaf, or cake, it must be either exposed to the sun's heat in the middle of the day, when the weather is fine, or (which is the safer way), be removed to a stove, kitchen, or some other warm and dry room, where a constant fire is kept, and the mass be well worked up together with the opium-knife, and turned daily, till it acquires plasticity sufficient to be moulded into the form required; after which, the cake must be turned frequently, till it be dry and hard enough to be committed to the chest. It is to be expected, that those persons who attempt to prepare this

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drug by the process and apparatus above described, will be at first a little dissatisfied; and be inclined to think that the method by which they are directed to collect the milky juice of poppies, drop by drop as it were, by means of so small an implement as a goose-quill, cannot possibly be the best and most effectual mode of filling the chest with solid opium. But they may be assured that neither the Turks, Persians, nor Hindoos, have any *more* expeditious way of obtaining the *succus proprius*, or real narcotic juice of the poppy.

If they patiently persevere, and proceed with care and diligence, rapidity of execution will presently be acquired; and they will soon be convinced, by experience, of the correctness of the wealthy accumulator's favourite maxim, that *many a little make a mickle.*

Dyrham, Nov. 25th, 1819. G. S.

Art. VII. *On the Progress of Steam Navigation in Britain.*

To the Editor of the *Quarterly Journal*, edited at the Royal Institution.

Sir,

In page 152 of this volume, there is inserted a notice of the number of steam-boats now in operation on the Mississippi, and its tributary streams, with an account of those which are building; presenting a singularly-interesting view of the immense advantages which will be derived by that rapidly-advancing country, from the introduction of this improved means of communication, peopled as it is with the descendants of Englishmen, and inheriting from their descent, all the active energy of character which distinguishes the parent stock. Interesting, however, as this statement must be to all in a philanthropic point of view, yet an account of the progress of the same system in our own country must be far more so, as even to us the practical adoption of this our native invention, holds out the most important results, and which are daily developing themselves with increased energy.

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It has been resorted to upon the Clyde to a far greater extent than in any other quarter of the United Kingdom, owing to the necessity of adopting the best means of communication between Glasgow, the second city of the island, and its two ports, Port Glasgow and Greenock. The formation of this Frith, besides, branching into various sea-water lochs, renders it peculiarly fit for this mode of conveyance, which has been lately infinitely extended by the completion of the Crinan canal, under the authority of parliament, laying open all the inlets of the western Highlands, and the Hebrides, to the use of the steam boat. The advantages derived from this circumstance, will be fully estimated, by all those who have ever made an expedition to Staffa a part of their Scotch tour, when it is stated, that the traveller may, by means of this conveyance, be now carried in less than 24 hours from Greenock to Oban. As soon as the Caledonian canal is finished, it is intended to continue the Fort William boat from that place, across the island to Inverness; and in furtherance of this plan, a vessel is to be placed on Loch-Ness early in the spring, while another is to connect the distant islands of Lewis and Skye, immediately with the most populous part of Scotland.

The following is a list of the steam vessels now plying on the Clyde:

No.	Names.	Sail to.	Tons.
1	Glasgow.	Greenock, &c.	44
2	Rothsay Castle.	do.	62
3	Clyde.	do.	46
4	Defiance.	do.	35
5	Mary of Bute.	do.	37
6	Margaret.	do.	38
7	Waterloo.	do.	59
8	Duke of Wellington.	do.	38
9	Greenock.	do.	39
10	Port Glasgow.	do.	55
11	Fingal.	do.	53

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No.	Names.	Sail to.	Tons.
12	Robert Burns.	Greenock, &c.	49
13	Allison.	Lairgs, &c.	64
14	Neptune.	Inverary, &c.	59
15	Argyle, 2d.	do.	67
16	Britannia.	Campbell-town, &c.	70
17	Samson.	Ingboat, &c.	50
18	Industry.	Luggage boats.	56
19	Trusty.		60
20	Active.		60
21	Despatch.		58
22	Robert Bruce.	Liverpool, &c.	91
23	Rob Roy.	Belfast, &c.	59
24	Sir Wm. Wallace.	do.	57
25	Comet.	Fort William.	

The steam-boat on Loch-Lomond is discontinued during the winter, but will recommence in spring.

It is understood that the Belfast boats will continue plying all winter.

The steam-boats on the Clyde are generally calculated to carry each 120 passengers, but they do not average more than 50 passengers daily throughout the year. The Rob Roy is fitted to carry 200 passengers, and has carried 220.

On the Frith of Forth there are four steam-boats, which upon an average during summer, carry 500 passengers daily.

As connected with this subject, the following account of the intercourse of this remote corner of the island is curious, exhibiting an interesting view of the habits of locomotion so characteristic of our country. The number of passengers which were conveyed along the Forth and Clyde canal, between Glasgow and Edinburgh, amounted in 1818 to 94250. Between Glasgow and Paisley, by the Ardrossan canal, 51700; and from Glasgow, along the Monkland canal, 18000.

Steam-vessels also ply on the Tay, the Humber, the Trent, the Thames, the Dee, and the Mersey; and the great success of

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the Talbot between Holyhead and Howth, promises fair to render the intercourse between the two islands as perfect as between two parts of the same island.

From these statements, it will be seen that we have not been behind our brethren on the other side of the Atlantic, in adopting this much improved system of conveyance; and in adapting it to our peculiar situation and circumstances.

Indeed nothing is so striking, or in fact more wonderful, than the extent and excellence of our public conveyances, and the means of communication which exists between every part of this kingdom by means of posting, stage-coaches, waggons, canal boats, and coasting vessels of all descriptions, proceeding from London as the common centre, and extending itself in every direction to the remotest corners of the country. Even the following very imperfect sketch will put this in a very striking view to those unacquainted with our country, and will serve as one point among many others, from which future ages may form some estimate of the extent of our wealth, our enterprise, and social relations; it may further be the means of inducing others to come forward from time to time with additional facts on this subject, tending to throw much curious information on so singular a part of our economical history.

It is calculated that a person has 1500 opportunities of leaving London in the course of the 24 hours by stage coaches, including the repeated trips of the coaches which ply the short distances. It is understood that about 300 stage coaches pass through Hyde-Park corner daily. There are about 40 Brighton coaches. There are 84 coaches belonging to Birmingham, of which 40 are daily; to Chester 19, of which 16 are daily; to Manchester 70, of which 54 are daily. In the year 1770, there belonged only two stage coaches to Manchester, one to London, the other to Liverpool, and they went only twice a week; there are now 20 coaches pass backward and forward daily between these two places. There are 60 coaches belonging to Liverpool, of which 56 are daily; to Preston 12; to York 18, of which 10 are daily; to Hull 12; to Newcastle 6; to Glasgow 13; to Edinburgh 39; to Aberdeen 9; and to Inverness 3.

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The mail coach establishment, by far the most perfect public arrangement ever attempted, and carried into practice, is now extended from Falmouth, through London, to Thurso; from the extremity of Cornwall to the extremity of Caithness; a distance of 1082 miles.

On the late meeting of parliament, one posting-house at Barnet, had out at the same time 54 pair of horses; what part of Europe could do the same?

But the same perfect system of speedy and comfortable means of communication, is not confined to land, for there are 25 smacks employed between London and Leith, the finest sea-boats in the world, and fitted up with every attention to comfort and elegance; performing each on an average, 13 voyages, or 26 trips, in the course of the year, and carrying 12 passengers each trip.

Between Leith and Hull seven smacks, performing eight voyages, and carrying two passengers each trip.

Between Dundee and London 10 smacks, performing 12 voyages, and carrying eight passengers each trip.

Between Dundee and Leith three smacks, carrying in the course of the nine summer months 180 passengers.

Between Montrose and London two smacks, performing nine voyages; carrying nine passengers each trip.

Between Montrose and Leith three smacks, performing nine voyages, and carrying nine passengers each trip.

Between Aberdeen and London 14 smacks, and between Aberdeen and Leith six.

Between Inverness and London five smacks, performing seven voyages; carrying 12 passengers each trip.

Between Inverness and Leith three smacks, performing eight voyages; carrying eight passengers each trip.

And between Inverness and Aberdeen two smacks, performing eight voyages, and carrying three passengers each trip.

There are 20 vessels employed in the trade between Glasgow and Liverpool.

There is one curious fact established by the foregoing statement, the great influence which London exerts upon the most

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distant parts of the island, giving as it were life and activity to the whole.

If these facts are considered by you as worthy of a place in your publication, they are much at your service; and it is hoped they may lead to further details on the same subject.

I am,

Your obedient Servant,

J. L.

ART. VIII. *On the Floatage of small heavy Bodies in Air, and certain Atmospheric Phænomena dependant thereon.* By G. W. JORDAN, Esq. F.R.S. *Communicated by the Author.*

LAMENTABLE complaints and serious, if we may judge from the characters of the persons making them, have been uttered and published respecting the pernicious effects on the health of the metropolis, produced by those dark volumes of smoke which are seen to issue from the chimneys of large dimensions and considerable altitudes, erected on the Surry side of the Thames. The remedy proposed for these supposed evils has been, to discover efficient methods of burning or consuming the smoke, and to require of the manufacturers to use these methods. These chimneys are by no means numerous in themselves, or as compared with the thousands of the metropolis; but their situation and their height expose them to observation, and has excited alarms which further consideration might have dispersed, or have induced a more ready acquiescence in their toleration and use. When a charge of fresh coals is first thrown on any one of these fires, a very dense black smoke is seen to rise, whose particles are scarcely capable of floatage in the atmosphere into which they are raised by the currents of heated air passing up the chimneys. This dense smoke, however, soon changes, and changes successively its density and colour, until it is scarcely visible. I have watched, and have scarcely ever seen more than three or four of these chimneys at one time discharging their thick volumes of smoke, and even

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whilst I have been observing, these have been changed to that state of vapour which is called, and considered as, burned smoke. What, however, is intended by a fire burning its own smoke? Does it mean the annihilation of all and every particle of coal thrown on the fire? Nothing can be more unphilosophical than this supposed destruction of ultimate aggregate particles, this annihilation of matter; and the particles, under whatever form rising, and rise they must, will again be precipitated. The precipitation of all that rises is of necessity, and perhaps the black form of undecomposed coal is the least injurious.

When a given quantity of coals is thrown on a fire, and after combustion a few ounces of ashes remain in the hearth, what has become of the remainder? It has ascended the chimney in the form of vapour, at first black, and afterwards grey, white, colourless, or transparent. The proposal to burn the smoke, or black vapour, assumes, that the black vapour is more noxious than the others, and this requires proof. Upon reflection, it would appear, that minute parts of the coal, simply divided so as to float in air, would be less noxious than the more active and offensive parts when decompounded. Of whatever colour the particles are, they ascend the chimney, and unless annihilated, are precipitated, and nothing is gained by this notable project of consuming smoke, but change of appearance in the vapour, and a precipitation perhaps more noxious. Of this, experiments may decide, but the decision promises to be of so little use as not to require the skill and industry of the chemist. As long as any fire continues to burn with or without flame, there is an emanation of heated particles, of particles of the air, and of the body, by whose union with air the heat is developed and continued. This may be perceived by the change of figure produced in bodies seen through them. The particles of the body are almost in a state of solution in the heated air, and, together with the heated air, change the places of bodies looked at through them. Ignited stacks of bricks exhibit these appearances after the gross smoke has passed away.

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But what is the number of these chimneys compared with those of the metropolis? What the quantity of coals used in these, compared with what is used in those? Those of the metropolis must be stopped up, or compelled to burn their smoke at the same time that these are interdicted, or compelled to burn theirs.

So objections were raised to the use of coal gas for the purposes of illumination, from its supposed injurious effects upon the health of the town, whilst every chimney in every house in town, where the fire flamed and burned, was burning coal gas. Noticing the foregoing inconsistencies, I have been induced to think it would be useful and amusing by the instances adduced, to develope the principles upon which the formation of vapours, and floatage of bodies, even the heaviest, in the atmosphere, depend.

In consequence of the attractions for water of the materials which form the base of atmospheric air, and of the heat upon which its gaseous state depends, water is dissolved in atmospheric air in given quantities at given temperatures. The solution is transparent. Upon changes of temperature, particles of water begin to be detached from the solution, in portions so very small, that their weights scarcely exceeding the attractions of the air which dissolved them, they continue to maintain their floatage in the form of clouds. When, by further accession of particles, these masses are increased in size and weight so as to overcome the attractions of the air acting principally on surfaces which increase as the squares, whilst the weights increase as the cubes of diameters, they are then precipitated and fall to the earth as drops of rain.

Water, exposed to the action of fire or heat in a given state of accumulation, is readily dissolved therein, and forms with it a transparent elastic gas, permanent at all temperatures above 212° of Fahrenheit, and called steam. In the steam, the particles of water are severally attracted by those of the heat surrounding them, and being removed to distances from each other, at which their mutual attractions cease, and those of the heat alone prevail, thus constitute with heat an uniform compound body, permeable to light in all directions. When, by

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diminishing the temperature of the steam, and the due proportion of heat, the particles of water approach to within distances at which they attract each other, the attractions of the heat by the diminished accumulation of its particles being also diminished, the particles of water run together, the mass loses its transparency, but the particles of water lose not their power of floatage, until by the further diminution of heat, and consequent union of particles of water into larger and larger masses, they form drops, and are precipitated, or by further diffusion of heat, and of the particles of water in atmospheric air, they are again attracted by the air, and again dissolved in it, even at lower temperatures than that of steam. When coals are exposed to the action of fire, vapours are thrown off more gross and black at first, subsequently, of colours less and less dark.

The exhibition from Meux's brew-house a few years ago, of the vapour of water from a steam-pipe, and at the same time of that of coal from a chimney close to the other, formed objects of curious and amusing observation. The beautiful white vapour from the steam-pipe, as contra-distinguished from that of the chimney, and the consideration that one was composed entirely of water, and that the other contained none or scarcely any, led to reflections on the general formation of vapours, and state of those of the metropolis, and the general principles upon which the floatage of small bodies in the atmosphere depends, which lead also to the explanation of many curious phænomena.

All idea of the repulsions of the particles of bodies by each other, and of light by bodies at any distances, as advanced by philosophers, has long been superseded by the better opinion and proof that what was supposed to be by the repulsion of one body, was effected by the attraction of another, and in the Newtonian observations, has been distinctly shown by repeating and varying his experiments on the inflections of light. One grand exception, however, exists in the case of heat, the particles of which repel each other, although attracted by, and attracting, the particles of all other bodies. The preceding observations confirm the doctrine in all cases of vapour from steam, of vapour from water in the atmosphere, and of dry

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vapour from the materials of combustion in ordinary fires. We will now proceed to other phænomena.

Some few years past, in a very fine morning in the beginning of October, between the hours of eight and nine, walking on Richmond Green, I observed very long filaments of spiders covering the grass, and advancing to the sun-dial placed on the Green and surrounded with iron bars, I perceived several of these filaments floating in the air from the pointed tops of all the iron bars. On the top of every bar, I found spiders standing, from each of whom a filament passed, and, recollecting Dr. Lister's observations on the flight of spiders by means of their filaments, watched the animals, in expectation of seeing them confirmed. I had not waited long before I saw a spider throw himself from the spike, and ascend into the air, together with, and attached to his filament floating above him. He mounted until I lost sight of him at a height considerably above the lofty elm trees which surrounded the green, and over which he passed, by means of the gentle current of air in which he floated. The pleasure and surprise of seeing this exhibition was scarcely inferior to that with which I first contemplated the ascent of a man in a balloon. In a very short time many others took their departure, and continued to do so whilst I stayed. More than once the floatage power not being sufficient, the filament and its burthen came down again, and the spider being received in my hand ran about upon it for a short time, again took its departure, and was soon elevated out of sight. Thus, the mode of conveyance of spiders was completely confirmed in all its parts, and it only remained to account for the phænomenon by the first observers ascribed to mechanical causes alone, but to be referred rather to the general cases and causes of the floatage in air of vapours, of particles of water, African sands, and volcanic dust, and introduced here with its explanation by way of illustration and confirmation of the doctrines advanced in the preceding pages.

When water is dissolved in air, its particles are held in solution by the attractions of the parts of the air on all sides surrounding them, which are then strongest on every part of

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the particle. When, by the accession of others, the particles are increased in their dimensions, the attractions of the air which sustain, and the weights which precipitate the drops, increasing in the before-mentioned proportions of the squares and cubes of the diameters, the drops quickly increase to sizes no longer sustainable in air, and immediately are precipitated. When, however, the union of particles is just beginning, and the new masses, in a state very near to solution, possess sufficient tenuity, floatage is produced and clouds are formed, and driven by winds through the atmosphere.

In the same manner, if the particles of any body, heavier or not than water, are, by any process, even the inverse of that just stated, by diminution from larger parts, not as in the preceding case by increase from dissolved parts, is made to arrive at a sufficient degree of tenuity, they will be as capable of floatage in the atmosphere as the smallest drops of water. The filaments of spiders possess this tenuity. They possess it, together with the power of sustaining the additional weight of the spider, when of lengths sufficient for the purpose. The spider, standing on a convenient station, continues to emit its filament until it is felt to be capable of raising and does raise him from his place, and then he abandons himself to its conveyance. Should this be done rather prematurely, he descends wherever it may be, lengthens his filament, and mounts again. That this is the case, appears from what I observed and have stated; and that the tenuity of the filaments is an adequate and existing, and therefore a true cause, the calculations of Lewenhoek show. He found that one hundred diameters of the filaments of grown spiders were only equal to the diameter of the hair of a man's beard, and the quantity of matter in a filament therefore equal to $\frac{1}{10,000}$ part of the quantity of matter in the hair. Of young spiders, estimated to be severally equal in size to $\frac{1}{400}$ part of a grown spider, and their filaments to be consequently in the same proportion, he estimated the quantities of matter contained in each filament to be only the $\frac{1}{4,000,000}$ part of that contained in the hair.

The action of the sun between the tropics, by heating and

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dilating successively portions of the atmosphere exposed thereto in the directions of from east to west, produces, as is well known, the trade winds of constant course in the same direction. These effects are principally produced at the surface where the heat is greatest by accumulation. In the evenings I have seen from the high lands of Barbados, the clouds and lowermost scud transported by the regular lower current of trade wind to distances to the westward of the island, meeting there a contrary current of wind, and returning back by a slow contrary course, at considerably increased altitudes over the island, and over the lower stratum of clouds. These changes of the currents of air I had repeatedly observed.

St. Vincent's is about seventy miles directly west from Barbados. In coming up from Martinique, I have been a week in a small schooner between both islands without seeing either. St. Vincents is generally not to be seen from Barbados; and yet, in a particular state of the atmosphere, I have, from the heights of Barbados, seen distinctly St. Vincent's, the pitons of St. Lucie, and the positions of Grenada and of Martinique, from the collections of vapours which then gather around, and hang over the tops of these and all the islands. In the night preceding the first of May, 1812, the inhabitants and the garrison of Barbados were alarmed by the noise of explosions from the westward, which seemed to proceed from fleets engaged at sea in that direction. At two or three in the morning, there was a strange sort of dust dropping from the air, which increased as the morning advanced. When day-light appeared, a large body of vapour appeared to the northward of east, slowing advancing over the island, producing, in a manner sufficiently obvious, a darkness in the quarter from which it came, carrying before it a bright portion of the sky bounded by an apparently circular line of dimensions successively diminishing until entirely shut in, and complete darkness covered all things.

The ordinary darkness of night, always illuminated more or less by star-light, was not to be compared to this. It was total and absolute. The eye could not see the hand.

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It was an Egyptian darkness that might be felt. The dust continued to increase, and fell in such large quantities as to cover every thing to the depth of more than an inch, and even to break down the branches of trees by lying on them. Between twelve and one o'clock in the day, a vertical shadowy light began to appear, the passage of light from the atmosphere above being shortest in that direction through the dust, in a circular form, which, as the dust thinned away, or drove on, increased in diameter, until the whole body of particles passed away visibly. By the impalpable particles of dust thus deposited, for many days men and animals were grievously annoyed; even the tender leaves of plants were injured, and the wind agitating the dust, the whole face of the country showed like the crater of a volcano. The volcano of St. Vincent's had burst out. The dust thrown by the explosions to considerable heights had, by the higher currents of air spoken of, been carried to windward during the night, and, descending into the lower regions of the atmosphere, was drifted back over the island by the ordinary trade wind a little to the north of east. During the fall, patterings on the roofs of houses, as of grosser particles than dust, were repeatedly heard, and some of the dust sent to me contained particles of stones, whose dimensions seemed to exceed all the power of floatage, so gross that I was led to conceive that they were carelessly taken up from the soil on which the dust lay. Other portions of dust were free from these.

An analysis of this dust in the laboratory of the Royal Institution, by Mr. Faraday, gives the following components:—

Silex	78,
Alumine	11,2
Lime	7,
Oxide of iron	3,4
Loss	,4
	100

This floatage power of small bodies may account for the dust

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said to be observed on the tops of the highest mountains, to which the finest particles of smoke, and of whatever solid materials may be adequately divided so as to be elevated and dispersed in air, may rise, and in a given state of rest in the air above unknown below, may quietly be deposited and undisturbedly repose.

These attractions of the air upon small bodies existing in it, and again of bodies upon small portions of the air, or of other bodies interposed between them, and of all these bodies upon light passing through or between them, lead to an explanation of optical phænomena, which is impossible without due consideration had of them. Thus I had been enabled to account for the irides which exist around and immediately contiguous to the sun, moon, and other luminous bodies, and are of various diameters, and of various successive orders of colours, which I shewed to be produced by the inflections of light in passing between bodies interposed between the eye and the luminary.

The great halo, of forty-five degrees diameter, has long been the *opprobrium philosophorum*. All who have attempted to account for its exhibition and dimensions seem to have failed. A diminished refractive power in the drops of water, forming it after two refractions without any reflection, seems to be necessary. Such a diminution of refractive power in drops of sufficient tenuity to constitute the permanently-floating vapour in which these irides appear, may be inferred from other phænomena, and being applied together with these to account for all the appearances of that iris, confirms and is confirmed by them.

Newton, Des Cartes, Huygens, and others, having assumed the number, or parallelism of certain rays, as principles of formation to account for the phænomena of the primary and secondary bows, these principles, not correct in themselves, nor extensible to other irides, failed in accounting for the halo of forty-five degrees. The true principle of the formation of irides is that of images, that is, by radiants; and to these radiants, not to parallel rays, nor to the number of rays, is the existence of irides as well as images to be referred. For cal-

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culation, rays are sometimes considered as parallel, but this only with a reference to their remote radiants.

Radiants, to constitute the before-mentioned first sort of irides of various dimensions contiguous to the luminaries around which they appear, are formed by inflections between the drops of water duly established by experiments:—to constitute the primary and secondary rainbows, they are formed by rays crossing one another, and thus forming radiants, at the limits of the single and double reflections of the rays within the drops, at points first ascertained by Des Cartes: and to constitute the iris of forty-five degrees, by external rays crossing each other at the limits of the points of refraction without the drops corresponding with the limits of the first reflections of the rays within, the refracted like the reflected rays removing from, returning towards the axis of the drop crossing each other at the points of return, and there forming refracted radiants, as the reflected rays form reflected radiants, and issuing from the same points. These points, however, according to the ordinary refractions of water, would give an iris on Newton's principles of fifty or fifty-two degrees, according to others of seventy-six degrees, forty-four minutes; and a diminished refractive power in the drops of water constituting floating vapour is necessary to exhibit an iris by two refractions of forty-five degrees diameter. The application, therefore, even of the true principle of formation by radiants, would not, as in the case of the first sort of irides, have alone been sufficient to account for the phenomena. In that case, original experiments and discoveries respecting the inflections of light, furnished the clue to perfect the discovery. In this, a change and diminution of the refractive powers of drops of water floating in air is necessary to be established. The extension of inflections to the phenomena of thin plates, and of bodies of considerable, of extreme tenuity, establishes what is required.

The iris of forty-five degrees generally appears in what may be called diffused vapour rather than clouds. At the distance of about twenty-two degrees and a half from the luminary there appears a circle of three or more degrees broad, as circum-

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stances favour, either white, or of colours more or less dilute, being internally red, and externally of the prismatic orders, or mixtures of these. These colours, as they are more vivid, are also more extended, even to twenty-six or twenty-seven degrees, and appearing in narrow and long portions of vapour, exhibit internal reds, yellows, and bright central mixtures of all the rays, emulating the sun in brightness, and gradually decaying away at increasing distances from him. One or two of these, seen alone, or in conjunction with other less resplendent parts of the iris, have received the appellation of mock suns. One of the most remarkable appearances which attend this bow, to be attentively observed, and to be carefully remembered in attempting its explanation, is a dark circle, or circular shade, appearing immediately within the preceding coloured circles.

If a globe of glass, filled with water, be exposed to the sun's light, or to the light of a candle, the rays which pass through converge from different points of the second surface to points in the line passing through the centre of the globe parallel to the incident rays. This cone of rays, received on a plane at right angles to the incident rays, exhibits a circle coloured with bright red on its external border, brighter yellow adjacent thereto, internally brightest white light within the yellow becoming more and more dilute up to the axis of the cone. On the external border of the red at the same time appears a dark circle or circular shadow, obviously produced by the extreme external parts of the globe intercepting all other light, and the light incident on the globe being all turned aside therefrom, and refracted entirely within the cone of passing light. The exact agreement of the iris in all its parts with these the phenomena of single drops, renders the conclusion irresistible, that it is formed from drops, by two refractions from drops of water. All that remains to be accounted for, is the variation of the diameter from what drops of water in other circumstances of other refractive powers would make it.

The colours and the dark line on the external edge or limb of the cone of light passing through the drops, prove that these colours come from those points in the drop which are the limits

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of first reflections. The black ring is formed by the edges of the drops from which all the light is turned aside, the coloured rings by light immediately adjacent to the dark ring, and therefore coming from the limits of refractions without and of reflections within the drop. There are no other points at which radiants by adjacent rays can be formed, and these determine the refractive power of the drops.

The ratio of 4 : 3 gives an angle of 38° : 22′, for the radius of the iris by refracted rays, coming from the limits of first reflections within the drop. By using Dr. Halley's construction for finding the angles of incidence and refraction of efficient rays after two refractions and one reflection, and assuming various refractive powers, in various trials, I found the refractive power of 65 : 61, to give sufficiently nearly the required angle of 22° : 30′ between the incident and emergent rays at the limits of first internal reflections, being double the difference of the angles of incidence and refraction of the same rays at entering the drop. This is the apparent radius of the iris, and therefore that is the refractive power of the drops.

The necessity of having small drops, all of equal adequate refractive powers, and of equal sizes, to prevent the changes of appearances which other drops would produce, might raise against this doctrine a question, which is, however, answered by the inference that permanent floating vapour can only consist of such drops, and this inference is thus exalted into a discovery. No other drops but of these refractive powers and sizes have powers of aggregation sufficient to resist for a time the solvent powers of air maintaining their floatage, whilst all of larger sizes are precipitated, of smaller are dissolved.

That a diminished refractive power of the drops is induced by the attractions of the air surrounding them necessary to effect their floatage as permanent vapour, is to be shown by reference to the phænomena of thin plates.

The phænomena of thin plates, contrary to the Newtonian hypothesis of fits of easy transmission and reflection, have been shown to be phænomena of inflection.

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When water is dissolved in air, it constitutes, together with it, a fluid perfectly transparent, all refractive power of the water, whatever it may be, upon whatever it may depend, ceasing. When separated from this state of solution, by the aggregation, from whatever cause, of the dissolved particles, their first action upon light passing through them, are of inflection by the air in which they float adjacent to each. By further accession of particles, globules are constituted, through which the light passes, and in passing in and out, is subject to the ordinary reflections and refractions of transparent bodies, by refractive powers, beginning at smaller sizes, and increasing as those increase, up to the ordinary refractive power of large masses of water in air. This gradual acquirement and increase of refractive powers obviously follows from the phenomena of thin plates of water in air, or of air between glass. In the case of a bubble of water in air, when the tenuity of the film at the top is extreme, it ceases altogether to act in that part on the light, which passes through, as if no body was interposed between the parts of air; at increasing distances from the top, the tenuity of the film increases, but not sufficiently to possess any refractive or reflective powers; the light arriving in the water between the parts of air adjacent to the water, is inflected by the air into two portions, one of which passes on, the other returns; and these inflections are continued and varied in orders, dimensions, and colours, until at last at increased distances and adequate thicknesses they cease, and the ordinary reflections and refractions are restored to the water at both surfaces of the film. As this is effected, *gradatim* not *per saltum*, these powers beginning and increasing pass through different states of intensity, from evanescence to their ordinary state. The same is the case of air between two plates of glass, and the evanescence, restoration, and gradual increase of the refractive powers of transparent fluids, in these and similar circumstances, is thus fairly established, together with every principle necessary to the formation of this iris.

These globules may occasionally be so formed and arranged into striæ of various directions, as at once

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to exhibit, by their refractions through the drops, the iris of forty-five degrees, with its coloured mock-suns, and by reflections at the surfaces of the drops arranged in longitudinal striæ, the white almicantars with white suns in them so rarely seen. By a small portion of unguent spread over the surface of a looking-glass, and disposed into various striæ of various directions by rubbing, strong resemblances of these white atmospheric lines extended to considerable lengths, and variously crossing each other, may be exhibited by the reflected light of a candle. If, therefore, this whole course of reasoning can be maintained, the whole theory of these atmospheric phænomena may be considered as established, by referring their formation from the number and parallelism of certain rays to the principles of formation of images by radiants, and from icy machinery of doubtful existence and application to globules of water, to floating globules, dependent for their floatage and diminished refractive power on the same cause, and to falling drops of fully-restored refractive powers.

I offer, not without due consideration, this explanation of these phænomena, certainly better, and better founded in its principles than all which have preceded, than the prismatic stars of ice of Des Cartes, and the snowy kernels and cylinders of Huygens, and certainly more consistent with circumstances, and the general order of things. I see distinctly in the globule or globular circle, the elements of the iris. I observe dimensions in the iris which require a refractive power in the drops different from that of water, in other its usual states of aggregation. I establish from other phænomena an adequate change of refractive power in the drops of the vapour; and to him who would reject these facts and their consequences, I would offer the propositions themselves and the conclusion, in the simple form of queries, after the example of Newton. They may, at least, be fairly enumerated conjecturally among observations on the causes and phænomena of the floatage of small heavy bodies in the atmosphere.

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ART. IX. *A Letter relating to* Mr. Watts' *Remarks on* Captain Kater's *Experiments*, &c., *addressed to the Editor of the Quarterly Journal.*

SIR,

I AM tempted to give you the outline of an article in the second Number of the *Edinburgh Philosophical Journal*, by a Mr. William Watts, of the Custom-house, Penzance, entitled, "Remarks on Captain Kater's paper, containing experiments for determining the length of the seconds pendulum in the latitude of London."

The writer begins by mistaking the length of the *seconds pendulum* for that of the *pendulum of experiment*; and in consequence arrives at the conclusion, that the number by which the square of the arc of vibration is to be multiplied "*is incorrect*," and should have been 1,645 instead of 1,635, the number given by Captain Kater.

He next convicts Captain Kater of not having expressed the number of vibrations made by the pendulum in 24 hours, beyond the *nearest hundredth of a vibration.*

He then proceeds to point out, that Captain Kater has committed an error in his computation of the correction for the buoyancy of the atmosphere in one of the 12 series of experiments, to the amount of *two hundred thousandths of an inch.* This being divided by 12, might occasion an error of about *two millionths of an inch*, in the length of the pendulum vibrating seconds. And lastly,

He asks, "why cannot the disappearance of the disk" (in the observations of coincidences), "be noted to a quarter of a second, as readily as an entire second;" or, in other words, why cannot an object be seen through a telescope when it is not in the field of view?

I am, Sir,

Your obedient Servant,

and constant Reader,

October, 1819. Z.

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Art. X. *Journal of a trip from St. Thome de Angostura, in Spanish Guayana, to the Capuchin Missions of the Caroni.*

[The following Journal is printed from the original Manuscript, for which the Editor is obliged to a near relation of the Author.]

October 29th, 1818.

Having agreed with Dr. K. to accompany me, and purchased a horse for 20 dollars, a mule for 45 dollars, and received another as a present from Bolivar, we started at 4 P.M.; our equipage consisted of myself upon a cream-coloured horse, the Doctor upon my little mule, each armed with a broad sword and a brace of pistols in our holsters; my boy John upon one mule, and my guide Anisette upon another, each armed with a rifle and sword, drove before them the baggage-mule, loaded with two portmanteaus and a bag containing biscuit, sausages, and one day's provision, with six bottles of good rum, salt, pepper, and other needful articles which we were given to understand were not to be had in the interior. Our intention was to go no further than Panapana, about six leagues' distance, where we expected to find the Doctor's cavalry. The day had been cloudy and cool, but without rain; our path lay on an elevated plain, skirting the banks of the Orinoco, which ever and anon shewed itself, rolling majestically along in the distance. I wished to push on, but could not get the baggage out of the ordinary mule's pace; and, being unable to distinguish my road among the innumerable cattle paths which crossed us in every direction, was e'en obliged to content myself with a most uneasy jog-trot. The country around Angostura is an elevated savannah, mostly covered with wiry grass and stunted trees, affording little shade. Looking southward, the land appears to rise; and from several points we could see a distant range of hills apparently clothed with wood. Occasionally occur the beds of torrents, in which the soil is rich and wooded; but in most places it yields barely sufficient for pasturing the mules and cattle, that are driven from the interior for the use of the capital. At about 1½ leagues' distance, crossed a small stream called the Cano-fistula, and 1½ league further another called the Marranta,

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whose sandy bed and deep channel shewed the sterility of the elevated surface, and the immense body of water it sometimes pours into the Orinoco. On the right bank stood a small village of the same name, once containing probably three or four hundred inhabitants; but the mouldering habitations, and gardens overrun with bush, attest its present complete abandonment. We had hitherto passed but one hut on our way; and the desolate aspect of the place gave us no favourable impression of this portion of Guayana. The sun was already going down, and we had three long leagues of nearly four miles each between us and Panapana. Jogged on, and just before dark, passed the rapid torrent Candelaria, then tolerably dry: had much rain fallen, we might have been detained some hours; but its vicinity to the Orinoco, prevents its continuing full long together. Groped our way onwards in the dark, scrambling over the stones in an unknown and scarcely perceptible track; but our beasts were fortunately more used to this work than their riders. At length half a mile of wood brought us to the banks of the Guaynare, which we knew to be near the end of our ride. But our difficulties were not yet over. The descent was steep; the water pretty deep, and my horse expecting to swim for it refused to advance, until I should *a Llanero*, dismount, take the saddle on my head and shew him the way. With much flogging and spurring, however, at last in we all plunged together, and reached the other side with no other injury than the wet: but it was between eight and nine ere we arrived at Panapana. The Commandant, Gaspar Uraca, unused to such late visitors, and just going to supper, turned out in alarm with spear and shield to receive us; but being answered in the usual tone of salutation, desired us to alight, and ushered us into his abode. We took up our quarters, *i. e.*, slung our hammocks over his counter, for his was the only shop we met with in the district. The village is conveniently situated, about half a league from the Orinoco; it once contained several Indian families; and, in the time of the Spaniards, actually furnished 100 men to the militia; but the war and the fever had made such havoc, that 48 Indians were the whole that remained; and these, with a few cavalry and Creoles, formed the whole population. The barren-

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ness of the circumjacent soil obliges them to have their provision grounds at above two leagues' distance, which not a little aggravates their distresses. We here saw a young man, who, ten months before, in crossing the Candelaria on foot, had been attacked by a cayman (alligator), that had left 16 wounds on his body. It seems he had by hard struggling and laying hold of the bushes, succeeded in repelling his assailant; but he himself attributed his escape to the vehemence with which he had invoked his tutelary saint.

30th *Oct.* The beasts were brought in at daylight; our course had hitherto been due east, never far distant from the river. We now turned to the southward, in order to gain the higher ground, and continued ascending across savannas, yet more arid and sterile. It was seven before we were fairly off, and the sun was already high by the time we had reached the most elevated part of the plains. The grass had been recently burnt, and the dreadful heat acting upon empty stomachs, made us ready to faint; but to halt was impossible, where not a drop of water was to be found, and of this we had made no provision. We overtook some naked Indians who had got the start of us; they were quietly toasting their tassago, (sun-dried beef), at a fire they had kindled, and this they devoured without salt or any thing but a little cassava. We did not anticipate how soon we should relish the same hard fare. At 11 A.M. came to a small stream, on the bank of which we spread our sail, and devoured a hearty breakfast of cold beef, cheese, and biscuit; but here we discovered a double misfortune; one of our rum bottles had been broken; our kind hosts at Pamapana had discussed a *seconde*, and the spring of our powder-flask being out of order, the gunpowder had been plentifully mixed up with our biscuit. But we were much fatigued, the place was tempting, a limpid stream at our feet, some fine palms overhead; our horses grazing in good pasture, with their saddles on, as the custom is. Every thing invited to repose. We lay till three, P.M.; when, after bathing and repacking, we pushed onwards; but we suffered for the indulgence: sleep had heated instead of refreshing us, and the reflection of the sun from the parched soil caused an eruption in my face, that I did not get rid of for a week af-

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ter. Our road lay in the same direction, S.E., for nearly a league, when we came to an abandoned hut that served as a resting-place, half-way between Palmasola and San Felipe. We here fell in with the main road to Angostura, and continued in a direction E.S.E., for about four leagues farther. The country visibly improving: well watered savannas, bounded by picturesque woody rocks, afforded excellent pasture for the cattle that we saw here and there among the bushes. We knew we were near the place of our destination, but could not discover it. I had gallopped on with the Doctor and passed the turning; had not I constrained him to return, we must probably have spent the night on the savanna. By good fortune, we caught our guide in the act of quitting the road as the sun went down. Our host, Colonel Mornio, received us kindly, and ordered for our supper some tassago and haropa, which we found excellent. On learning who were his visitors, he gave us every information we required. San Felipe is a farm-house, prettily situated at the base of a stupendous black rock, which rises apparently in one block from the plain, between 5 and 600 feet nearly perpendicular. I am told there is a cavern in it accessible on horseback, and capable of containing 50 horsemen. The summit must command a beautiful view of the meandering Caroni. This is, in fact, a *hato*, or cattle-breeder's station; it once belonged to a respectable family of Angostura; who being Royalists, the Government seized it and converted it into a depôt of cattle for that city, where those driven down from the missions are halted and fattened. The pasturage is reputed excellent, and water abounds in the neighbourhood. The number of cattle there at the time of our visit was about 1,000. It is distant from Angostura from 16 to 17 leagues; from Carnache, about four leagues. We slung our hammocks for the night in the gallery, with our baggage all around us; having recommended our beasts to be secured in good pasturage for the night. A sound sleep recruited our strength after two days' fatigue.

31st. Our friendly host treated us with a profusion of milk, which we tempered with a drop of rum; and at eight, A.M., accompanied us through his domains, skirting, as we went, a very

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pretty lake, lying at the foot of the above-mentioned rock. I inspected the cattle *en passant*—they were grazing in a fine savanna, and surrounded by horsemen that had just collected them to drive them off to Angostura. Took leave of our host here; and, pursuing our route, soon ascended an elevated plain. On reaching the summit, the beautiful prospect of the rocky Caroni, with a stupendous barrier of woody mountains, on the eastern side, burst all at once upon us. It was truly a magnificent scene. The river, about a mile broad, studded all over with rocks and wooded islets, made a wide sweep from the southward, until, at length, its waters were collected into one broad navigable channel, where the ferry had been established at Carnache;—beyond, it was again broken by innumerable islets, and falls at least 200 feet before it reaches the level of the Orinoco. We reached its margin about 10 A.M. rousing two deer in our path; and, while the canoe was crossing towards us, prepared our beasts for the passage, by unsaddling and fastening a long rope about their necks. The canoe was manned by five Indians; besides whom, it admitted three of us, with part of the baggage: one horse and one mule swam along-side; the boys holding the rope by one end, and encouraging the animals by their voice. The canoe soon returned for the rest; and, in 40 minutes, we had effected the passage without accident, notwithstanding the great rapidity of the current. Breakfasted under the trees, in order to refresh the beasts, and afterwards proceeded to Carnache, a mile further. Reached this place about one, P.M.;—being the first mission, it naturally excited our curiosity. It stands on a pleasant spot, upon the right bank of the Caroni, about 10 leagues above its junction with the Orinoco. As all these Indian towns are built nearly upon the same plan, the description of one will serve for the whole. On the south side stands the church, and contiguous, on the east, the building is continued upon a smaller scale, so as to form the Padre's house, and, on a still decreasing scale, the dwellings of his officers, &c. Behind this range of building, are the kitchen, curing-house, store-rooms, cotton-press, and other works. In front, on the north, is a large open space or square, behind which are seen

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the Indian huts, laid out with the utmost regularity. The buildings, not excepting the church, are generally constructed of upright posts, fixed in the ground, with a lattice-work of twigs filled up with clay, so as to resemble a mud wall. The roof is plastered in the same fashion, and then tiled. Windows, except in the church, are rare, and always cut out and the frame-work inserted, after the wall is finished. The Padre's residence is always furnished with good doors and paved with tiles: when kept clean, it is a truly comfortable abode; but, cleanliness is seldom observable. The Indian huts have no door but a large hide, and are floored with clay. The domestic cookery is carried on in the inside, upon the floor; these people seem to think they cannot exist without smoke. The exterior of the buildings, and the interior of the church and monastic residence, are usually faced with white clay, which, in the absence of lime, gives an air of neatness that is a mere deception, for washing the apartments is never practiced. The Indian huts are commonly long and narrow, 50 feet by 15 feet, divided equally into three dwellings, each having a door-way in front, and another behind, and appropriated to a single family. The gardens or provision grounds are invariably at some distance; a high barren spot being selected for the village as the more healthy. Carnache was settled in 1763, with Indians mostly of the Caraibbe tribe: in 1803, it contained 418 inhabitants; the fever, conscription, and desertion, have now reduced the population to about 100, and these very sickly. A few creole families have settled here for the sake of the trifling trade occasioned by the passage of the cattle; but, the cows excepted, every thing bore marks of want and misery. The commandant had gone with all the able-bodied people to Murucuri, to get in the corn, which was abundant, but without hands to gather it. In the afternoon bathed in the Carmi; the water dark-coloured, but clear, and said to be strongly impregnated with sarsaparilla, which grows in wild profusion higher up. It was a luxury to swim without apprehension of the cayman: the nature of the water, and frequent rapids, seem to have protected this river from his intrusion. Took up my quarters in an inside room: the Doctor and people,

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afraid of contagion, slung their hammocks in the gallery. Observed a singular effect of the fever: most of the children who had suffered, remained with swelled bellies.

1st *Nov.* Prepared to move at day-break. It had rained in the night. Our road lay mostly through the woods, and their coolness formed a delightful contrast to the parching heat of the savannas, which had so much disfigured my complexion. Traversed some agreeable savannas; some of them coated with good pasture. At about two leagues' distance entered the ravine that conducts by a gradual ascent up the mountain. On either side, thick and impenetrable forest; but, where an opening appeared, the view highly romantic. Ascended continually for about five leagues: the road sometimes good, sometimes so steep and worn by the torrent, that it was scarcely possible to keep our seats. It was evident by the surrounding heights, and the stream, that for miles accompanied us, that we were still in the ravine. Grass for our beasts was looked for in vain, so we took advantage of a pretty resting-place to breakfast. Though 11 o'clock, the great elevation and thick foliage made the air quite chilly, and gave an excellent relish to our gunpowder biscuit. The road was fenced on both sides to prevent the cattle, on their passage to Angostura, from straying into these forests, where they must inevitably perish. To meet with a herd in this narrow pass, would be somewhat perplexing. After an hour's rest, continued our route, and at length arrived at the summit, where we found a small spot cleared, and an empty hut for the accommodation of travellers. Water we still found, but no living soul: indeed, in these dreary wilds, the human face rarely greets the eye until the journey's end. Descending, still through the richest woods, abounding with cinchona, and other medicinal shrubs, at last opened a savanna, in which stands the village of San Antonio. Had heard much talk of robberies, and had kept close, but no danger had presented itself. No sooner had we entered the savanna, than our guide, in visible alarm, pointed to a shed, where lay the corpse of a negro. Soon discovered that the poor fellow had not been murdered, as our guide supposed, but had fallen a victim to the fever: yet so much had

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Anisette's fears obscured his judgment, that he hurried us on with the intimation that we had got full three leagues to go. San Antonio or Unrisatono is prettily situated in an extensive savanna, girt about with mountains, and at a considerable elevation. The spot seems very healthy; but the fever had penetrated to this, as well as all the other missions. The commandant, and all his people, with more than 100 Indians, were lying sick; every house presented a scene of horror. This town of 56 buildings, in 1803, contained 802 inhabitants: not 30 people remained in health: 230 had already died: burials four per day; despair visible in every countenance. There is here excellent pasturage, but few cattle. The surrounding hills are rich enough for any cultivation. Cotton and tobacco thrive in the savanna; but rice and cassava seem the principal products. The buildings are on a smaller scale than at Carnache, but the church pretty; the tinsel and rude ornaments of the altar-piece evince the Indian taste for finery. A tolerable image of our Saviour had been brought from Spain. It seems to be a principle of the Capuchins to do every thing themselves; this, and all the other images and paintings we saw, were the work of Capuchins. We found here abundance of cinchona, which it never entered into the heads of the people to make use of, though the fever was intermittent: the commandant promised to try it himself, but deemed it impossible to persuade the Indians to make the experiment.

2d. Set out for Upata: the air pure and cool; very different from what we had felt on the banks of the Orinoco: followed the level of the savanna, in a direction east by south: the herbage good and well watered in many parts: soil light, but fertile: rocky hills occasionally projected on the view. A range appeared to run parallel on the north. Southward the plain seemed to extend to the savannas of Pastora; in fact, a road breaks off in that direction. At half-past 10, breakfasted on the remains of our wallet: found clear and excellent water. Our beasts revelled in the finest pasture: they had become so familiar, that we could turn them out without apprehension. At Carnache we had drunk of the salubrious Carmi. San Antonio is princi-

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pally supplied from some large ponds, in one of which I bathed. A beautiful spring, about a mile distant, and carefully covered in, supplied the residence. Pursuing our course along the savanna for about five leagues from San Antonio, came to the foot of the range of thick-wooded mountains, which separated us from Upata. It appeared to run in a line N.N.E. by S.S.W., and is doubtless connected with the lofty ridge, which bounds the immense tract of level we afterwards came upon. On first entering the thicket, the trees were short, mostly brushwood, but visibly improved as we advanced. Soon arrived at the highest point of the road, whence we gradually descended for above two leagues, through a most beautiful country: soil much richer: trees more lofty, and abundance of water, as we conjectured from the frequent beds of torrents, some of them quite empty. On our approach within two leagues of Upata, saw many little plantations of sugar and coffee, but more of provision-grounds, maize, rice, plantains, cassava, &c., on either side. The canes appeared to thrive, a proof of good soil. In fact, with the heavy rains that fall in this tract, and the vast deposit of vegetable matter in these interminable forests, the soil must be equal to any production. The weedy state of the grounds, and filth of the comfortless huts, shewed the indolence of the cultivators. At two P.M. arrived at Upata, the capital of these missions. Found the Commissioner Uscategui very ill of the fever: he gave us a melancholy account of the whole neighbourhood—but received us most kindly, and assigned us quarters in a vacant habitation, the owner of which was upon his *conuco* (plantation). Revived his hopes with the assurance that his malady was curable, and that we would not leave him until his recovery. He invited us to dinner, but we had already refused an invitation from the Commandant Lanz. Our quarters were, a house built of clay, consisting of a sala with a door in front, and another in rear; a bed-chamber with one window, and a kind of store-room with none. The greatest economy seems to be observed in the construction of these habitations—carpenter's work rare, and not a nail throughout. Obliged to borrow a table and two chairs;

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and, with the addition of our hammocks, the house was as well furnished as most in the place: the walls were studded round with pegs, on which our chattels were suspended.—After dinner sallied out to survey the town. Upata was settled in 1762, as the intended capital of the missions, and residence of the Spanish inhabitants; who, though necessary for defensive purposes, were studiously excluded by the padres. It stands beautifully on a rising ground, the centre of an amphitheatre of hills open to the south-east only, where the savanna stretches away some leagues. It is about midway between the Orinoco and the southern missions, and, though in a valley, may be said to stand near the centre of the elevated ridge, which divides the waters of the Orinoco and Essequibo. Thus it affords an admirable military position, and a focus for the traffic of the district, for which purposes it has been chosen with great judgment. The fertile hills around supply all its vegetable wants, and a considerable surplus for exportation; the plains to the south-eastward abound in cattle. The town is laid out in rectangular streets, but the houses are mean, and mostly of clay, with no symmetry, elegance, or ventilation. A stream of fine water winds round two-thirds of the town, and, though now dry at times, might, with little labour, be made to yield an ample supply. The soil of the savanna, though rocky, is in some places rich; and the pasture greatly improvable. In 1803 the town mustered 769 inhabitants, and from the number of unfinished houses, must have been rapidly-increasing until the breaking out of the revolution. The little *conucos* in the neighbourhood, contained probably 2,000 more. In the afternoon, visited U——, and administered comfort in the shape of calomel; he was labouring under a quotidian intermittent, which came on about nine A.M., and lasted until three P.M. Had suffered much from want of medicine; for although the neighbouring hills were covered with cinchona, and many persons had even prepared the extract, none knew its properties, or thought of applying it to the cure of the prevailing disorder. The commissioner attributed his own attack to a visit to Guayana Vieja and San Miguel, where the pestilence had raged in full violence; but it does not appear

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that he felt the symptoms until some days after his return to Upata. Its prevalence in this town he attributed to the presence of the troops, for whom a quantity of cattle had been slaughtered, and the bones and offal left to rot in the streets, as usual among this indolent people. The country had always been considered healthy, and the fever never been known before this season; but now its ravages were dreadful; one fourth of the population had been carried off, and it proved more destructive to the Indians than to the Creoles. Conversed with U——— upon many interesting topics, particularly the practicability of opening a communication with Demarara, which Piar had unsuccessfully attempted. Found him well-informed and communicative, though somewhat vain of his talents. He is a native of New Grenada, tall, very thin, with an expressive Spanish countenance; and was rapturous in praise of his native province.

3d *Nov.* Staid at home to recruit after our journey. Anisette despatched to procure coffee and sugar, and some maize for the beasts. Maize cost us three rials the almud, eggs four for the rial, papellons two rials a piece, fowls from two to eight rials; beef we got for the asking. In the afternoon walked round the town, and discovered a box of Frontignac wine, on which luxury we laid violent hands, at 1½ dollar per bottle.

4th *Nov.* Rode out early to ascend a steep hill, 600 feet in height, on the south side of the town. The view from the summit by no means compensated our fatigue. Descending, with difficulty, we remounted, and followed the path to a small neat plantation we had descried from the top. Here we found a habitation surrounded by cocoa-nuts, coffee, and orange trees, with a small patch of tobacco; another of plantains; and at some little distance the *yaca*, or cassava ground, and maize plantation; all in a small way. The venerable owner welcomed us in the most agreeable and polite manner to his humble home; his wife, a notable dame, gave us coffee and fruit; and two strapping daughters were grinding maize for the breakfast of the young family; a poor miserable boy was groaning in the next room, and dying of a wound in the foot,

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which had mortified for want of surgical aid. He had been draughted for the cavalry, but having become unserviceable from an injury to the ancle, was sent home without any attempt to cure him. The doctor attended the dressing, and gave verbal instructions; which, however, would have been too late, had they been attended to, which the old lady took care they should not be. This poor man had been every way a sufferer; his peons had been taken off, and himself and all his family attacked by the fever; the weeds had overgrown his plantation, and he was in the lowest state of poverty. Returning to town, found the commissioner much better, which gave us confidence, and induced us to delay our journey till we could pronounce him out of danger. The fame of our arrival had spread far and wide, and applications to the doctor poured in from all parts; patients abounded, for the most part cases of fever: having very little medicine, it was difficult to satisfy all. Bark and *hijeretta*, or castor-oil, were the only medicines procurable; but all dreaded the trial of them. One old woman only had confidence enough to persevere in the use of bark, and she recovered.

4th. At half past six A.M. made an excursion for about a league to the northward. Crossing the brook, passed a small savanna, and entered the woods. A steep and rocky ascent lay before us. No sooner had we surmounted this, keeping the Alta Gràcià road, than we entered upon a beautiful little vale, studded with small *conucos* of the richest appearance. Visited seven or eight, each seemed to cover about 30 acres; they belonged to creole families, who cultivated with their own hands, and those of a few slaves, occasionally hiring the Indians to assist in getting in the crop. Cultivation chiefly of provisions, with a little coffee and cotton; the former appeared to thrive. Soil rich, but the exuberance of weeds indicated the ravages of the fever and conscription. Scarcely a man was to be seen. Rode up to one to procure information about the cinchona; the family was at breakfast on rice and haropa, the favourite food: a very small piece of meat served to flavour the mess. Calabashes and fingers were the only utensils of the

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well-furnished repast, and each, squatting down near the fire, drew from the pot his own portion. The family consisted of the wife and sister, the daughter-in-law, and another woman, all whose husbands were absent with the army, a great boy ill of the fever, and a numerous younger progeny, all of whom had suffered, or were suffering. Alas! thought I, what benefit have these people derived from the revolution? The sight of a dollar soon brought me a plant of cinchona, and darting through the woods to the right, we returned by the banks of a torrent to Upata. Cinchona grew in profusion all around us, and is generally met with on the summits of the hills; it is a shrub about 14 feet high, with long lank branches, crowned with triple leaves, each eight inches by four; blossom white, in bunches of three flowers; smell, very strong. I saw no stem above six inches thick; the bark is yellowish brown, and more bitter than even the Peruvian. The powder by itself is apt to purge, but made into an extract, and taken with spirits, is nearly equal to the genuine: the leaves burnt, exhale a fine aromatic smell; dried, and used as tea, they make a beverage not unpleasant, though, from my own experience, very diuretic. On our return, found our patient much better; but recommended a second dose of calomel. Accepted an invitation from Tarife, to visit his hacienda, or sugar estate. We had attended his wife and child, and he wished to show us some attention.

6th. Accordingly set out with him this morning, and pursuing our former road northward for half a league further, ascended the mountain which separates the savanna of Upata, from that of Alta Gràcià. Turned on the summit to the right, and traversing woods abounding with cinchona for another half league, found ourselves in a beautiful glen, in which were two sugar plantations. In the hollow ran a mountain-stream, on either side lofty hills, covered with perpetual shade; on the small level at their foot, the rich soil produced the canes in great perfection. The space was shared between two proprietors—Tarife occupying the lower portion. Found things conducted on a better scale than elsewhere. His mill was, indeed, constructed of hard wood, and so required to be re-

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newed every two years; his boiler consisted of one miserable iron kettle, in which the cane juice was boiled, not into sugar, but into a thick sirop, which, poured into small holes cut in a block of timber, formed little *papellones*, or loaves, not detached from the melasses. In lieu of a cask, an immense block had been hollowed out, to form a cooler for the worm of the still, and other things on the same footing. Yet his rum and sugar were better in quality, and more in quantity, than those of any neighbouring planter. The works, worm included, were of his own contrivance; and he had invented a plough of hard wood, the only one in all the province, with which he prepared his ground for planting. It was worked with two oxen, and was of two pieces only, in this form.

With this rude, but ingenious machine, he contrived to work 1,500 yards of a rich light surface. Tarife had once 13 slaves on this property, but most of them had been taken off; the remainder were all affected with the fever, and his canes rotting on the ground. He assured us this little estate yielded about 2,000 dollars per annum, besides supplying all the wants of his family in town. No doubt, any produce might be raised here; but the difficulty of communicating with the river is a serious evil. A bad road, of 16 leagues at least, across a tremendous range of hills, renders it impossible to transport any thing above a mule's burden. It cost him the labour of 30 men, for five days, to bring up a still. He was endeavouring to hire a few Indians, at one rial per day. Returned with our host in the afternoon. U——— had been taking bark all day, and was much better.

7th. Remained at home drawing a bark tree: patients mending, all but one, rather refractory.

8th. Determined to ride over and visit Lauda, at Cupapuy. Accordingly, took a southward direction across the savanna for about a league: found on its skirt a few scattered huts.

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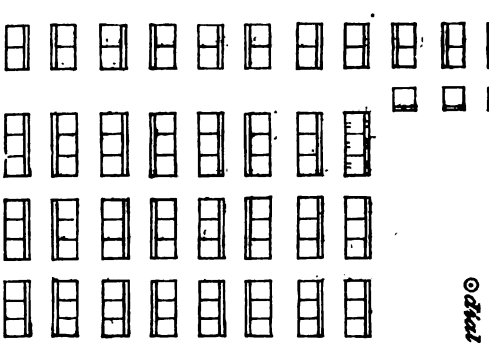
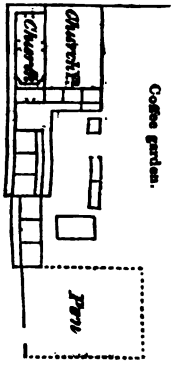
Plunged again into the forest, and passing a range of hills, fertile as usual, emerged upon an elevated flat, where stands Cupapuy.



Indian houses, three in one, with gallery in front.



Plan of Cupapuy.

This is one of the largest missions. It was planted in 1733, and in 1803 contained 957 Indians of the Guayano, the most docile tribe. It is beautifully seated upon an elevation of 500 feet above the neighbouring plain, and has always been most healthy; yet, here we first witnessed the pestilence in all its horrors. Of 7 or 800 still remaining, we counted 439 sick of the fever, and dying at the rate of twelve or fourteen per day. From what we could learn, it originated in San Miguel, where a great number of cattle had been slaughtered for the army. The stench of bones and offal, left, as usual, in the open square to rot, had so infected the air, that not a single Indian remains there alive; and all the vagueros and herdsmen who had come down with the droves, returned with the fever, and spread the infection all over the country. The Indian mode of treatment tends to aggravate the effects. When first attacked, the patient commonly bathes the

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head and body with hot lime-juice; and, lighting a good fire close to his hammock, refuses all sustenance but lemonade, until actual debility puts an end to his misery. The doctor and myself were persuaded that more died from starvation, than the mere effects of the malady. In fact, in many instances, the whole family was so debilitated, that not one could go to the *conuco* for provisions; and the people in office paid them no attention, delivering out rations to those only who were in public employ.

Cupapuy contains, exclusive of the residence and offices, forty-four buildings, subdivided into 122 dwellings. Some were altogether deserted; most contained from four to fourteen sick. Many had fled to their *conucos* to avoid contagion. We observed a custom, when any one died, for the whole family to evacuate the dwelling for a given time; the office of burial is generally abandoned to the females. The frequency of deaths precludes all attention to religious rites.—Accompanied the mayor-domo to the tobacco-ground. A space of about 20 acres of the cassava grounds had been cleared, and 80,000 plants put into it. The planting took place so late, and the rains had been so scanty, that the produce was but small. The spot is a league from the village, and has been furnished with a large shed, where, to our infinite horror, we found a poor fellow in his hammock, who had died that morning. His companions were hard by, eating their breakfasts with little concern. Cupapuy has the advantage of a short distance, of two leagues only, to Upata, and of the vicinity of the hills, where are the provision grounds of the Indians. The capuchins seem to have made a point of selecting a healthy spot for the village, with little care about the distance of the provision grounds, on which the Indians were never suffered to remain for any length of time. This was, perhaps, the only way of breaking them of their nomadic habits, and making their labour so profitable, as it must have been, to their pastors. This village formerly possessed 3,000 head of cattle; the number is now reduced to 300, which must soon be exhausted. Leaving Landa some pills, and recommending the use of bark, we re-

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turned, about four P.M. On the road, met a despatch, announcing U———'s relapse.

9th. Spent the morning with our patient, who was much better: his fever had changed from quotidian to tertian; and, as this latter is not considered alarming, he reckoned himself convalescent. He told us, that when he came down from the pure air of New Granada to the plains of the Apure, he had been affected thus for eight months successively, yet was obliged to be in motion all the time.—The whole country about the Apure, being flooded in the rainy season, ague is very common. A young lady of the family informed us, that one season Paez being obliged to winter in the Savanna, she had been confined to a hut built upon stilts.—The missions were originally settled by the capuchins in 1721, in which year Caroni was built; their number continued to increase until about 30 years ago, since when no new establishment has been made. Tumeremo, the last, settled in 1788, still exists, being composed of the Guayano tribe; but the three settled in 1782-3, Cura, Curucuy, and Arechica, being composed of Guaycas, a mountain-tribe addicted to nomadic habits, have been wholly abandoned; and Ayma and Santa Clara will probably soon share the same fate. The Guayanos, being of a milder and perhaps more servile disposition, and better disposed to civilization, form the bulk of the population. The Guaycas, who occupied eight, are a spirited tribe of more open and manly countenance, and fond of liberty. During the late conscription, they mostly took to the woods: some have returned, and others been forcibly brought back; but the major part have resumed the savage habits they had been imperfectly weaned of. The Caraibbes, who occupied seven, are of that sturdy race that so long resisted the Spanish arms. It is wonderful how the padres could ever have surmounted their antipathy: but this tribe was the second that they attempted between 1748 and 63. Though pretty well broken in, they retain many features of their former character, have resisted the forced levies, and, in some instances, united into predatory bands, and, when pursued, blood has generally been shed. The main body of the

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tribe has retired into the lands of the Essequibo, whence they communicate with Demarara. In fact, the padres seem to have been in the practice of going on hunting parties, in order to collect recruits for their establishments; and thus to have entirely cleared this district of the native tribes, who might have allured their proselytes to rejoin them in the forest. By their regulations, the Indians worked alternately one fortnight on their own provision-grounds and for themselves, the next for the community, in other words, for their spiritual directors, either in the cultivation of cotton and coffee, in making or repairing the buildings, *&c.*, or the like; and, as a strict attendance upon religious duties was enforced, their time was fully occupied. When the Patriots first took possession, two years ago, liberty was proclaimed to the Indians; but afterwards the demand of provisions for the troops in the field growing urgent, they were required to give the half of their labour to the government, until the complete establishment of the republic. The padres took care, in return for their labour, to supply them with clothing of their own manufacture, and with attendance in sickness, besides the regular rations, which the abundance of cattle afforded; but, for want of proper superintendence, all these matters have been neglected since the Patriots have had possession; and the cattle, the grand resource of the country, shamefully wasted. The capuchins had 50,000 or 60,000 head of reclaimed cattle, at the lowest computation, besides those running wild in the forests and savannas: the present stock does not exceed 15,000; consequently, much discontent prevails among the Indian population, which has been aggravated not a little by their imputing the fire to the contrivance of their new masters. Should the war continue five years longer, I much fear it would end in the entire depopulation of the province. Respecting the communication with Demarara, I learnt, that Piar, on his first conquest of this district, and before he had possessed himself of Angostura and the channel of the Orinoco, spent eight months in endeavouring to cut a path or road to the Essequibo; but having neglected the advice of the Indians, and taken a wrong direction, he worked into the mid-

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dle of an impassable morass, and was obliged to abandon the project. His design was to send thither 600 mules to purchase arms, of which he was in extreme want. God knows how Governor Murray would have relished the visit. The river Cayuin is accessible enough, but so full of rocks and rapids as not to be navigable. Dr. Burton, when obliged for some reason or other to fly from Demerara, had, with the assistance of the Indians, found his way overland to Upata; but could not remember the track. No doubt, an advantageous channel of intercourse might be opened with little expense, especially if an English colony were established in this part of the country.

19th. Returned this morning to Cupapuy to visit Landa, and complete our inspection. Found the administrator still sick of the fever, the bark having purged him, and his wife persuaded him to discontinue it; indeed we found the general prejudice so strong that it was impossible to persuade him to recommence; besides, petticoat government interfered. Visited the looms, where the cloths are woven for the Indians; they are of the simplest contrivance, much after the East Indian fashion; the cloths coarse and irregular, but they thicken in the washing: spinning is performed entirely with the hand and spindle. Besides the regular establishment, which works for the public benefit, nearly every habitation is furnished with a loom for the manufacture of hammocks, which the elder matrons sell for their private account. They are generally very substantial and striped with blue: the price from four to ten dollars, according to quality. All these works had been suspended by the fever, and though many had been begun upon, we saw none finished off. Next visited the blacksmith, whom we found tolerably intelligent. The shop was but rudely furnished, but he shewed us he could make nails, common hinges, and the like. He seemed to regret the loss of the padre. I told him the English would bring doctors and padres too. Oxala! was all his answer. Proceeded thence to the tannery, which consisted of a shed with three or four immense wooden blocks, hollowed out into vats for the reception of the hides and tanning matter. The latter is prepared from the seed

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of the *dividivi*, a tree resembling the tamarind in appearance, and very common hereabout. The seed is gathered in the pod when nearly ripe, bruised, and thrown into the vat, where it is steeped in boiling water, till all the tanning property is extracted. It is more astringent than the bark of oak, and is excellent for ink. I had a jaguar-skin tanned with it in five days. The carpenters' houses were distinguished by doors and windows, but for want of saws to cut timber into plank, their work is confined principally to the frames of the houses. The cotton gins are simple, and upon the common Berbice principle. Petacas, or boxes of hides, are made here, as well as saddles, of a rude form. The fever had not abated; nine were buried yesterday, five this morning. Witnessed the mode of beating out the rice. Twelve stout wenches were employed in the gallery of the church, with short sticks, with which they beat time to a song. They appeared healthy and cheerful. On our return, found the commissioner again ill, but satisfied with the regularity of the fit. He talked of passing a few days at a *conuco* in the mountains, the only one that had belonged to a Godo, (Spaniard,) and, of course, confiscated.

11th. Breakfasted with U—. He was cheerful and better, and had ridden out in the morning, so we trusted in his speedy recovery. He was expecting Cornejo to see us forward on our journey.—At mid-day, resolved on a trip to Alta Gràcià, about eight miles distant to the northward, on the main route to San Miguel. Passing our former road, we continued straight on over the mountains, in lieu of turning to the right towards Tarife's. The descent was long, steep, and so much torn up by the rains as to be scarcely passable. Soil rich for two miles beyond the mountain, and excellent in two or three plantations by the way-side. In one of coffee, with a hedge of limes and oranges, we observed more care in the cultivation than we had yet seen. Entered a large undulated savanna, with a surface apparently of sandy clay, intersected by a stream of water. Good pasture in many places. A mile and a half off this savanna brought us to Alta Gràcià; once a considerable establishment, but now of most desolate appearance. Indeed,

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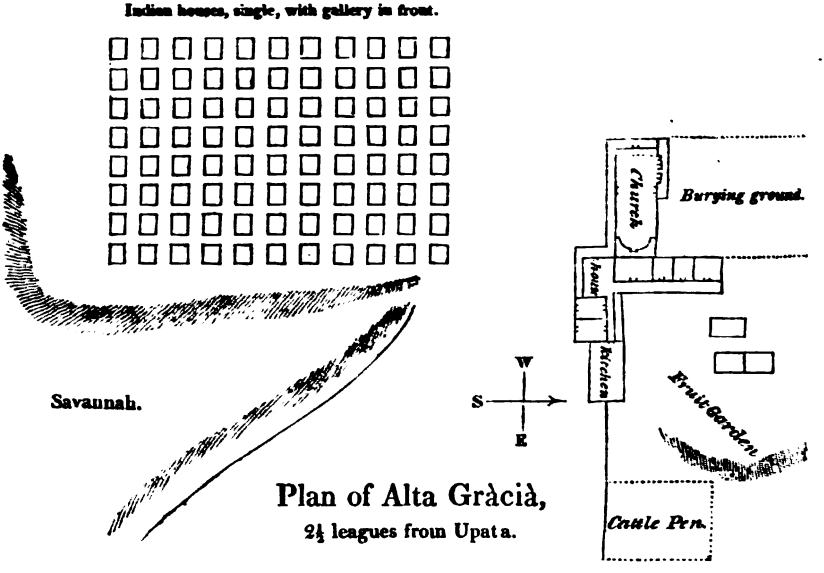
most of the missions have a still and gloomy aspect as they are approached. Clay huts disposed in perfect regularity, all in one cluster, with no tree to relieve the eye, and the tall church lording it over the humble roofs, and placed at a marked and formal distance, leave a melancholy impression of these monastic settlements.



Plan of Alta Gràcià,
2½ leagues from Upata.

Alta Gràcià consists of eleven rows, of eight houses, each ranged in straight lines, on the slope of a high hill, facing southward. The church and monastery, or residence, occupy the north side, and beyond are the garden and well-peopled cemetery. We rode up, as usual, directly to the residence. Not a living creature answered our call. All around was solemn silence, except where a famished dog muttered a growl at our intrusion. Made fast our horses, and proceeded to search the house; and, at length, unkennelled two boys, a sick officer left behind by Pigott in charge of his baggage, and a lame soldier, almost the only tenants of a long range of building. From them learnt that the Commandant

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and his deputy had both gone to Upata ill of the fever, leaving in charge an old man of fifty-six, the mayor-domo or officer formerly intrusted with the cattle. The old gentleman soon returned from visiting the Indian captains. He gave most doleful details of the ravages of the fever. All the Indians able to crawl had withdrawn to the woods, and were dying fast. The houses were nearly all abandoned. Visited six, and found three or four old women administering food to their expiring families; but there was little hope of their recovery, for there were none to go to the grounds for food. The mayor-domo declared, that more had died from starvation than fever; and that being the only person in health, he was himself obliged to kill the animals assigned for their rations, and to distribute to each his small pittance. But all their cattle had been slaughtered at San Miguel, and they were entirely dependent for supplies upon Upata.—This place has extensive tobacco and cotton grounds. Soil around very fertile, and pastures excellent; but labour wholly suspended by the pestilence. We found here as at Cupapuy, a cotton press, worked by a wooden skrew, turned by the labour of four men: there were also a few bales of cotton packed in hides. The church very neat, and just re-beautified. The cherubims of Indian workmanship afforded a curious specimen of progress in the art of painting. Some brass swivels in the yard induced me to ask their use in such a place. "For defence," replied our conductor; "I remember the time when this neighbourhood was thronged with wild Indians inimical to these establishments, who often attacked us, and would soon have extinguished the padres, had they not procured these arms from Angostura." "So then the padres were not always upon good terms with the native tribes?" "Oh no; they came in by persuasion, but maintained themselves by force; and when once strong enough, sought to aggrandize themselves at the expense of those who refused to submit to their yoke." He expressed his firm persuasion, that the English would soon come and take possession of the country, and ardent hope that he might live to reap the benefits of their fostering protection: "Are they not spreading all over the

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world!"—Alta Gràcià was settled in 1734; in 1803, it contained 800 inhabitants. Its convenient position made it the depôt for the levies raised by Anzoategui in the missions; and the wanton waste of his soldiery is attested by the horns and bones scattered in every direction. It does not appear that the fever broke out till the preparations for their embarkation caused a frequent intercourse with San Miguel, whence we may therefore presume the infection to have been brought. All the neighbouring villages, San Felix, Caroni, Murucuri, and Alta Gràcià, had been nearly stript of their inhabitants. This spot appeared well suited for an European colony; the air salubrious, pasture abundant, soil rich all around, and separated from Upata by a range of hills about 1,000 feet in height, and from the noxious vapours of the Orinoco, by one still more lofty and extensive.—Returned at a smart pace in an hour and a quarter. Having observed much cinchona on the road, inquired of a friend its similarity with that of New Granada. Were informed the species was different: the tree much larger, and leaf broader.

12th. Determined to visit Tarife, who was ill at his Hacienda. His fever had just left him: he was in his mill-house making sugar, having succeeded in hiring a few hands; four mules worked his wooden roller, and, considering the rudeness of the machinery, and want of iron, got on pretty well. The sugar is made without lime, merely boiled down into a thick sirop that cakes as it cools: the moulds conical, four inches diameter to eight perpendicular, with no hole at the bottom for the molasses to run out: the loaves sell for two rials each. Partook of an excellent dinner of fowl and tassago, which, when well prepared, is certainly preferable to fresh meat; a pudding of rice, boiled with cocoa-nut milk and sugar, was excellent.

13th. Resolved to explore our way to Santa Maria. The road was pointed out across the savanna in a south-easterly direction; but, in the multiplicity of tracks, lost our way, and crossed the hills by a small plantation into the Cupapuy road. Struck off eastward, and passing many pretty meadows on the banks of a stream of water,—at length espied Santa Maria

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on the summit of a hill before us. Colonel Matamoro, the commandant, received us with more than usual courtésy; and, while breakfast was preparing, shewed us his garden. Besides various kinds of vegetables, it contained about an acre of vines trailed over a sort of arbour, whence the grapes hung in thick clusters, both white and red. They were excellent, and we did them full justice; but the large red ant had made cruel havoc, and threatened their total destruction. In vain did we light fires upon their nests: myriads still succeeded the myriads destroyed. The arid soil was ill adapted for gardening, but the air favourable for every kind of vegetable produce. Santa Maria stands upon a table land at the foot of a range of hills, separating it from Upata. It commands a most extensive and beautiful view. The plains on the south, lower than the level of Upata, are bounded by a more distant range of hills; those on the east stretch farther than the eye can follow. This mission was the second established by the monks in 1730. It consists of 62 buildings, of three huts each; and, in 1803, contained 570 inhabitants. At present, the fever is raging with full violence—counted 125 sick, which exceeds the total convalescents that we saw; but most of the people have retired to their conucos. About one, the fiscal and a gang of nearly twenty women returned from gathering corn, each loaded with ears as full and fine as any I ever saw. The offices was, as usual, mounted, but the girls on foot; they had brought their loads two leagues. The crop had been abundant; the whole destined for the state. Cotton and provisions are the sole produce of this place. Of the former, a good crop was expected: the press-wall all ready. Matamoro shewed us the seed and wood of the *dividivi* or *watapan*, assuring us that a hide took but five days to tan; the wood hard, and capable of high polish. There is here a tannery, and a shoemaker, who was ill of the fever: the price of a pair of shoes ten rials. Rice and cassava are cultivated with success; indeed the mission is adapted to every kind of produce. There is also fine pasture for cattle; but most of them run wild at present; also, a large *potrero* for breeding horses. Game, and many species of wild animals,

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abound in the plains. Dined on beef and rice, with excellent maize-cakes, made with eggs, and returned in the evening, distance four leagues. Crossed the hills at the back of the town; and, in the savanna on the other side, found some well-watered pastures, where a drove of horses were grazing. This savanna of Upata is long and narrow, bounded on either side by a range of mountains; in most places it is adapted for the plough, and the cultivation of corn and rice.

14th. Remained at home to write.—Cunejo's delay was accounted for, by intelligence that Cumamo, a mission under his jurisdiction, had been abandoned by the people, and a detachment of Indians sent in pursuit, murdered to a man. Determined to proceed alone, if C. did not arrive, and, persuaded U. to try his strength in a trip to Santa Maria for a day or two. Also procured from him a map of the missions to serve as our guide: accordingly inspected our arms and accoutrements, and prepared to start next morning. The Doctor brought two bottles of rum from Tarife, one of which I strongly impregnated with extract of bark, which I had found an excellent thing for the stomach, and took as a preventative, morning and evening: of this I filled my riding-flask.

15th. Set out in company with U. and his brother-in-law, bidding adieu to our kind hosts. Jogged on in the direct road, and arrived in three hours at Santa Maria. The commissioner fatigued by the heat of the sun, but much benefited towards evening: mounted, and strolled out to a hill called Calvary, which intercepted our view of the subjacent plains: the hill was itself rocky and barren, but the view superb, and embellished with the rays of the setting sun. Southward and eastward, the plains extended to the horizon: beautifully varied with woods and savannas. The site of some neighbouring missions, as denoted by adjacent hills, was pointed out to us. Palmar almost due E. Cumamo Miamo o Carapo, S.E. Pastora, nearly S., Puedpa, more to the W., and Euri, nearly W. by S., but none of them visible.

16th. Killed a sheep, of which there were but 12 in the mission; and which, together with the calves, were regularly

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driven into the yard every night: the mutton sweet, but not fat, but, with the vegetables, made a good meal. Our intelligent Llanero, Captain ——— left us this morning, and was succeeded by Moreno, who is, I believe, a native of these parts: passed the evening in hearing the manner in which the poor Padres were surprised after the defeat of the Godos. All agreed, that, had they united and raised their people, they might easily have expelled the invaders. As it was, all the monks were butchered but one, who was sent home with the intelligence of the massacre: made two petitions—both granted:—1st., to be allowed to cut up the next bullock in our English fashion. 2d., to dissect the corpse of the next person who should die of the fever.

17th. A detachment of about 20 cavalry passed through this morning: one, a fine lad, was retained as our guide: they were all armed with spears and guns: six good troopers could have cut up the whole party. The despatches for Angostura were closed, and sent off. In the course of the forenoon, the corpse of a poor woman brought for burial, was stopped for dissection in the church-yard, and the Fiscal ordered to attend the operation, excluding, of course, all other Indians, lest their prejudices should interpose: but the women's curiosity was not to be restrained, and it was only by employing a boy to pelt them with stones, that we could prevent their looking over the wall. However, they saw enough to set about the most absurd tales, as that the Doctor had purloined the gall, bladder, and liver, in order to compound his pills, and the like. K. proceeded with great skill, and as much apparent pleasure as I should have in carving a round of beef. The two Indians attended the whole operation, though sometimes obliged to retire a little from the smell: the symptoms were as follows:—

Water of the pericardium of a yellowish tinge, about 1 oz.
Right lobe of liver much enlarged and diseased.
Blood vessels of stomach turgescent.
Omentum, ditto
In the stomach, no contents, but yellow bilious fluid.
Spleen, a mass like grumous blood.

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Pancreas much hardened.
Blood vessels of intestines turgescent.
Bladder nothing peculiar.
Gall bladder, containing 6 dr. of dark green bile.
Kidneys of natural size, but very white,
Water in ventricles of brain, about 1 oz.

—Prevailed upon Matamoro to promise us his company on the morrow, but the sight of the corpse had so discomposed him, that he had a smart touch of the fever, and was obliged to take medicine.

18. M———, too ill to travel, so made an excursion southward, into the plains, for about two leagues: crossed a fine savanna overgrown with high weeds, and came to a channel now almost dry; but the height of the foot bridge shewed the depth of water after rain: passed a lake, on which were some large ducks: the land about it swampy, but rich. On returning, the elevation of S. Maria was perceptible by the difficulty of the ascent: it rises at least 600 feet above the level. The beef at dinner, killed yesterday, after the English fashion, was a proof that it would keep good for two days. M——— being better towards evening, resolved to start next day.

19th. Up by day-break, having 14 leagues to go: delays of packing, &c., made it six before we were off: descended by the same road as yesterday, but turning off to the left, soon entered a succession of most beautiful and fertile meadows, powdered over with tufts of wood, and abounding in deer and other game. Our cavalcade was numerous. Mr. K——— and myself, John Anisette, and our soldier, with an Indian servant of M———, could not get within shot of the deer. Two soldier birds rose close to us, but my rifle was behind. This bird is about four feet high, in shape resembling a goose, but the beak broader at the tip; plumage white, with a ring of red and black round the neck. They must live on fish or aquatic herbs, for they were always found on the borders of lakes. Came to the cattle ground about three leagues distant, where we saw a spirited chase of a horse by five cavaliers; their object was to drive him into the pen; to catch him was impossible. Road still rich

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and beautiful, skirting a lofty ridge of mountains running from west to east, but at some distance from the base. At length arrived at a vast enclosure resembling an English park, kept up for the breeding of horses. It is considered half-way. Found an empty house, or rather shed, where we breakfasted, turning our horses out to graze, secured by a long rope. Rested in this enchanting spot for about an hour and a half, and then proceeded. The road more rocky and uneven, and the soil less fertile; passed a house pleasantly situated on a little hill, with a garden and tobacco ground attached; it was occupied by a negro, who seemed happy in his hermitage. Entered a savanna skirted by wood, and said to abound in jaguars: had not gone far before we started a species of racoon, who afforded capital sport, but being myself in the rear, the mules were not active enough to stop him, and he escaped wounded into the bushes. Soan started another racoon; took the lead and drove him into a small thicket where we surrounded him, and fired three shots, two of which hit him before he would start. The animal we killed is called a wild dog, which he resembled much, but his head was like a fox's; skin spotted like the leopard, but good for nothing, being mangy. The land higher as we advanced and more undulating. Soil still rich in many places. Approaching Palmar the grass was on fire: this is the Spanish method of clearing the land, and doubtless tends to impoverish it, but makes the herbage in the plains sweet and excellent for cattle. At three P.M., reached that pretty little mission, the best laid out we had yet seen.—

[The conclusion of this journal, with a map of the traveller's route, will be given in our next Number.]

ART. XI. *On a Substance produced during the Distillation of Coal Tar. By* W. T. BRANDE, Sec. R.S., Prof. Chem. R. I., *&c.*

SOME years ago I received from Mr. Clegg, engineer to the Gas Light and Coke Company, a small quantity of a brilliant white crystalline substance, which I was informed was benzoic

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acid; and that it had been found in the condensing vessel of the coal-gas apparatus. I then paid no further attention to it than slightly to examine its properties, and finding it not acid, and insoluble in liquid ammonia, merely concluded that it was not what it had been represented.

Very lately, I am indebted to Mr. Jennings for a large supply of what I consider to be the same product; he informs me that it is produced in considerable quantities in the first and second distillation of coal tar; that it gradually precipitates from the oil, and that every hundred gallons deposit about five pounds of it; that the deposition is greatest in cold weather; and that it is consequently probable that the oil, even when highly rectified, retains a portion of it in solution.

The substance, when freed from empyreumatic oil, is inodorous and insipid; it is extremely volatile, and fusible at a temperature a little below that of boiling water. Its vapour condenses in brilliant needles, and plates; the latter appearing hexaëdral, and often perfectly transparent. After fusion, it concretes with much expansion, on cooling, into a soft fibrous crystalline mass, of a specific gravity little exceeding that of water. It is highly inflammable, and during combustion throws off a very remarkable quantity of carbonaceous matter. It is insoluble in water.

Alcohol sp. gr. 820, readily dissolves this substance, and acquires an acrid and aromatic flavour. The solution is decomposed by water, and a milky mixture results. Hot alcohol appears to dissolve it in any quantity; and as the solution cools, it is deposited in beautiful crystalline flakes.

Sulphuric ether, at common temperature, also dissolves it in large quantities; and fine crystals are separated during the spontaneous evaporation of the solvent.

In chlorine, this substance fuses spontaneously, and evolves fumes of muriatic acid; the gas is absorbed with the production of heat, and a compound results, apparently analogous to that obtained by the mutual action of chlorine and olefiant gas. Intensely heated in chlorine, it deposits charcoal, but does not burn.

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It dissolves in acetic acid, and is not much more soluble in the hot, than in the cold acid.

Muriatic acid scarcely dissolves it.

In sulphuric acid, when aided by heat, it dissolves in considerable abundance, forming a deep violet-coloured solution, which bears diluting with water without decomposition. The alcalies produce in this solution a white flaky precipitate, and if diluted, the mixture becomes curiously opalescent, in consequence of the separation of numerous small flakes.

By long-continued boiling with sulphuric acid, a portion of carbon is deposited; but the greater part of the substance volatilizes unaltered.

Repeatedly distilled with nitric acid, this substance appears to suffer scarcely any change; a portion is retained in solution, by the acid, which is precipitated by dilution, and another portion passes over unaltered.

In the caustic and carbonated alkalis, it is scarcely soluble.

This substance appears to suffer no change whatever by repeated sublimations, at temperatures above that of boiling water; and what is more curious, is, that its vapour may be passed through a red hot tube without decomposition; if received into a cool glass globe, it crystallizes in white plates as before.

Fused with potassium, it scarcely acts upon that metal; and as the mixture cools, it oozes from it in brilliant globules.

Such are the few experiments which I have hitherto been able to make upon this peculiar product. It bears in appearance so strong a resemblance to the fatty matter of biliary calculi, that I was once induced to consider it nearly of the same nature; but, as Dr. Wollaston remarked to me, it is not only much less fusible, but considerably less volatile, than that compound, and perhaps approaches, in most respects, nearer to the properties of camphor, than of any other known body; though, as the above experiments tend to shew, it exhibits several peculiarities.

Its remarkable indestructibility by heat; the circumstance of its neither affording water nor carbonic acid, when heated in close vessels, and its very trifling action upon potassium, are circumstances which induce me to believe that it contains no

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oxygen; and which, in conjunction with the effects produced upon it by chlorine, lead me, for the present, to regard it as a binary compound of carbon and hydrogen: in respect to the proportions, however, in which these elements are combined, I have not yet as been able to satisfy myself.

Upon another occasion I hope to give some further details respecting the above product; and to examine another substance, which Mr. Jennings informs me he has obtained during the rectification of coal tar.

Royal Institution,
Dec. 20, 1819.

Art. XII. *On* M. Carnot's *Theory of Defence by Vertical Fire.*

M. Carnot, influenced probably by motives which it is not our business to expound or inquire into, has promulgated some singular doctrines respecting the defence of fortified places by *vertical fire*, a system which has long been acknowledged as furnishing an important accessory mean; but not, we believe, till M. Carnot's proposal, ever thought of as the basis of defence.

Sir Howard Douglas has published a small tract, entitled, "*Observations on the Motives, Errors, and Tendency, of* M. Carnot's *Principles of Defence*," which has furnished us with the following paragraphs; and which may serve to remove the erroneous impressions, which authority so high as that of M. Carnot might otherwise produce.

M. Carnot recommends, that the besieged should begin to make use of vertical fire upon the commencement of the construction of the third parallel; and from that stage of the siege, keep up an incessant discharge of musketry and four-ounce iron balls, at great elevation, upon the enemy's works, so as to form a rain *(pluie)* of shot upon the trenches. The iron balls to be discharged from a number of 12-inch mortars, two of which are placed in the salients of each bastion and ravelin, in the front,

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or fronts, attacked; each mortar throwing 600 balls at every discharge.

M. Carnot introduces his theory of the effect of these balls by observing, that of any number which fall in the trenches, the number that take effect will depend upon the proportion which the unoccupied part of the trench bears to the part which is covered by the men posted and working in it. Thus, supposing a man standing upon an horizontal plane, to cover a space of about a foot square, and a man in the attitude of working somewhat more, M. Carnot calculates that the projections of the bodies of the men, usually working and posted in the trenches, will occupy about $\frac{1}{180}$ part of their surface; from which he infers, that of every 180 balls that fall in the trench, one should, according to the doctrine of chances, hit a man; and he does not doubt that it will put him "*hors de combat.*"

M. Carnot's idea of the effect of this "*pluie de balles,*" is founded upon the velocities which he supposes they will acquire in accelerated descent from the vertex of a very elevated curve. This is manifestly the principle upon which he tries to establish his theory; and this it is which, disregarding for the present the doctrine of chances, Sir Howard Douglas first remarks upon.

"It is quite clear," says he, "that M. Carnot has formed his theory upon the parabolic hypothesis, which is the theory of a projectile's flight in a non-resisting medium. This theory, considerably erroneous in all cases, is particularly and greatly so with small projectiles; and its deductions, as applied to the velocity of descent of small balls used in very elevated short ranges, are quite fallacious. The velocity of the ball in a horizontal direction (which by this theory would be constant, and to the projectile velocity, as radius to the cosine of the angle of elevation), being inconsiderable, it is evident that the effect of vertical fire must depend upon the velocity of descent in the direction of the curve. Estimating this according to the parabolic theory (as the secant of the angle of elevation), the motion would be slowest at the vertex of the curve, and the velocities of the projectile be equal at equal distances from that point. According to this supposition, we should assign to the descent

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of small balls, discharged at an elevation of 75o or 80o, such accelerated velocities, as would, if true, be quite sufficient to do good service in the way M. Carnot suggests; but the fact is, that there can be no acceleration beyond a limit which, with small balls, is very much less than is generally imagined.

" From the vertex of the curve, where all the vertical motion is lost, the ball begins to descend by an urging force which is nearly constant, *viz.*, its own weight. This force would produce equal increments of velocity, in equal times *in vacuo;* but in air, the descent of the ball being resisted more and more as the velocity accelerates, the urging force will, at a certain velocity, be opposed by an equal resistance of air; after which, there can be no further acceleration of motion, and the ball will continue to descend with a velocity nearly terminal."

In considering this problem as applied to vertical fire, Sir Howard Douglas remarks that, M. Carnot has entirely overlooked *terminal velocity;* " and I shall show," says he, " from his own words, that this is the case. It is not necessary to exhibit here the investigations by which I have established the impotency of M. Carnot's vertical fire; I shall only state the results, not to embarrass the conclusions with abstruse matter. The solutions are computed from the theorems given in Dr. Hutton's tracts; and although the results may differ a little from the truth, yet it is quite clear, that in the descent of the balls there can be no acceleration of motion beyond a certain limit;—that with small balls this velocity is very much less than persons who have not investigated this curious problem would imagine; and that M. Carnot has evidently overlooked this circumstance.

" The velocity which a musket ball has acquired when the resistance becomes equal to the weight, or urging force of descent, is only about 180 feet in a second. The potential altitude, or the height from which the ball must descend *in vacuo*, to acquire a velocity equal nearly to the terminal velocity, is 523 feet. Hence, in the first place, it would be a waste of means to use the full charge; for a musket-ball fired upwards with the ordinary quantity of powder, would be pro-

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jected to a greater height than 523 feet; and it is evident that all above this is unnecessary.

" The indentation which a musket-ball, moving with a velocity of 180 feet per second, makes on a piece of elm timber, is about $\frac{1}{10}$th of an inch: this might, perhaps, be sufficient to knock a man down, if by great chance it were to fall upon his head; but in no other case would it put him " *hors de combat.*"

" Now, as to the four-ounce balls. The diameter of a French four-ounce ball, is one inch, two lines, five points; which, reduced to English measure, is 1.28038 inches.

Its content is 1·09909 inches.

The weight is 4·72247 ounces, if made of cast iron,
and 4·8624 if of wrought iron.

The terminal velocity of the cast-iron ball, is about 201 feet.

The terminal velocity of the wrought-iron ball, is about 204 feet.

The potential altitude of the cast-iron ball, is about 631 feet.

Ditto ditto wrought ditto ditto 650

" M. Carnot recommends that the balls should be made of hammered iron; but adds, that as the charge of powder for a mortar is small, balls of cast-iron may resist the explosion without breaking, and will answer as well. Now this observation shows that the author had not considered the effect of the air's resistance, nor doubted a sufficiency of force in his vertical fire: for the weight of a ball of hammered iron, is greater than that of a ball of cast-iron of equal diameter; and the superior weight, or urging force, of the former, would generate greater terminal velocity than a lighter ball, of the same size, could acquire; the momenta of the two balls in question, would be as 19 to 18.

" Four-ounce balls, discharged at elevations even considerably above 45°, to the distance of 120 yards, would not inflict a mortal wound, excepting upon an uncovered head. They would not have force sufficient to break any principal bone; there would be no penetration, but merely a contusion. This certainly would not oblige the besiegers to cover themselves

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with *blindages*, as M. Carnot imagines; for a strong cap or hat, and a cover of thick leather for the back and shoulders, would be sufficient protection from the effects of his vertical fire with small balls.

"As the quantity of balls required to feed mortars discharging 600 balls at a time would be very considerable, M. Carnot observes that cubes of iron, of 8 or 10 lines side, cut from square bars of this dimension, may be substituted. These, he says, may be fired from mortars, howitzers, or stone-mortars, and will produce the same effect as balls (page 491, Carnot.)

"Let us consider this:

10 lines French are equal to ·89523 inch English.
The content of the cube is ·71746
Its weight is .....3·0822 ounces.

"Now take a *ball* of the same weight:

Its diameter is ..... 1·111 inches.
Its terminal velocity is..... 185 feet per sec.
Its potential altitude is ..... 534 feet.

"We have no experiments from which we can ascertain the terminal velocity of square shot; but from comparative experiments with round and flat surfaces, we know that the resistance of the air to the flat end of a cylinder is more than double the resistance to a ball of the same diameter. Thus, although the urging force of a ball and cube of the same weight be the same, yet the surfaces upon which the resistance acts (and very irregularly in regard to the cube) are very different:

The surface of the ball is ..... 3·87045
——————— the cube is ..... 4·80862

"From this, together with what has been said respecting the descent of *balls*, we know, and that is enough for our present purpose, that the terminal velocity of the cube must be much less than 185 feet per second; and, consequently, its effect or momentum inferior to that of a 3·08 ounce-ball. The motion of a cubical shot will, besides, be quite irregular, descending sometimes with an angle, then a face, then an edge foremost,

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tumbling over and over in oblique, irregular directions, without any certainty, excepting that the velocity and effect will be much less than those of a round shot of equal weight*."

ART. XIII. *An Account of the good Effects of the white Oxide of Bismuth in a very severe Stomach Affection of a Gentleman far advanced in Years. By* G. D. YEATS, M.D., F.R.S., *Fellow of the Royal College of Physicians, &c., (communicated by the Author.)*

MANY years have now elapsed since Dr. Marcet published a very clear and explicit account of the good effects of the white oxide of bismuth in certain painful conditions of the stomach. Relying upon the recommendation of this medicine, as coming from so respectable an authority, other practitioners very soon made trial of it, and were much gratified in finding that it answered the expectations of the curative powers which had been attributed to it. Among those who have since more particularly called the attention of physicians to this subject, is Dr. Bardsley, of Manchester, who, in 1807, published some interesting and instructive cases in his Medical Reports. Some insulated cases have also been published in the medical journals, confirming the high character given to the medical virtues of the oxide of this metal. In reviewing the cases which have been presented to the public, I do not find the age of any one

* As a practical exhibition of the doctrine of terminal velocity, Sir Howard notices the descent in the parachute, of which the aëronaut, detaching himself from his balloon, falls with accelerated speed until the resistance of the air to the expanded canopy becomes equal to the total weight of the descending body, after which it falls to the earth with uniform velocity nearly. To the man of science these illustrations may appear superfluous, and perhaps obtrusive; but the author knows from experience, that such familiar illustrations are necessary to convey his meaning to those who, like the theorists of no remote period, make no allowance for the resistance of the air, which is now known to be such that a 24 lb. ball, moving with a velocity of 2,000 feet in a second, would suffer a resistance of 800 lb. nearly.

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patient to exceed fifty-five years; and, as the patient whose case I am about to relate, had, for a long period of years been afflicted with distressing pains of the stomach, was past seventy when the treatment was first commenced, and when the symptoms were so violent as justly to excite a suspicion of much organic mischief about the stomach, I am induced to believe that a detail of it will add considerably to the good opinion entertained of the bismuth; and will contribute to diffuse still wider the benefits to be derived from an exhibition of this valuable medicine. I am aware that the result of the operation of a medicine in an individual case can prove nothing decisively of its good effects; but, when such individual statement comes in confirmation of many other cases, it must have its weight in the recommendation of the adoption of a medicine not previously very generally resorted to. In this point of view, therefore, I trust the perusal of the following case will not be without its utility.

January 21, 1816. P—— C——, Esq., æt. 71, complained, at the beginning of winter, of pain about the pit of the stomach, attended with much eructation of wind, and costiveness. The appetite is rather deficient, but it varies; it is not accompanied by any morbid thirst; the tongue is foul; pulse full, slow, and soft; a wasting of the flesh has taken place; the urine is of the natural colour and quantity; there is nothing remarkable in the colour of the fæces. No uneasiness is complained of by pressure on the epigastric region. The pain is troublesome at various times during the day, but is most distressing between ten and eleven o'clock at night, when it comes on with intolerable violence, and to such an extent, as to cause vomiting, when the matters thrown up are very liquid, great in quantity, and extremely acid; some relief from pain is then obtained. Sometimes the pain returns in the night, so as to destroy rest. It occasionally shoots to the back, and produces a slight dyspnœa for a short time. The pain is not brought on immediately upon taking food, but he describes it as occurring about three hours after meals, by a kind of fermentation, and a sensation of weight, as if the food

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had never passed from the stomach. In the winter of 1814, these distressing symptoms continued so long, and with such violence, as greatly to injure his general health, and to produce a considerable degree of emaciation, with a dry brown tongue, and a slow, weak, intermitting pulse. At that time he was restored, after some mercurial medicines, by the *mistura ferri composita*; but he was never long free from pain, although it was much mitigated. At the beginning of the ensuing winter, it returned with considerable violence, when the *mistura ferri* was again resorted to with some temporary relief. Bark and various other remedies have been given without benefit; the most immediate relief has always been obtained by large doses of magnesia and chalk in cinnamon water. The dose of these absorbents was taken in such quantities as to produce an uniform white appearance in the feculent discharge. Reflecting on the cases which had been published, and in which the white oxide of bismuth is so strongly recommended, I determined to have recourse to it. Accordingly, about six weeks ago, he began with five grains three times a day, mixed with some tragacanth powder. Relief being obtained, the dose was increased to eight, then ten, and lastly, to twelve grains, thrice a-day, with such decidedly good effects, that P. C—— called upon me yesterday, and said, he had been free from pain and uneasiness for some time, although he had occasionally, by way of experiment, indulged with impunity in such articles of food as had formerly very much disagreed, and that he had omitted taking the powders for four days, and no pain had returned. The bowels had been generally regular, but it was sometimes necessary to take a few grains of the compound of extract colocynth. Thus, this venerable gentleman has for the last three years enjoyed considerable comfort by the use of this medicine, and this relief from pain he would, most probably, not have experienced, but for the bismuth; for, during the three years which have elapsed since he first took it, the pain has at times returned, but has been uniformly removed, by having recourse to this mineral. Having experienced its good effects in this way, he has always had a packet of the white oxide by

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him, and, when necessary, has taken a small quantity in a tea-spoon, without weighing it, every evening for several nights. Age, and its attendant infirmities, are now, I regret to state, pressing upon him, as society will be deprived of one of its most useful and valuable members. His old grievance is occasionally troublesome with the other symptoms of declining years; and the probability is, that some organic disease exists about the stomach, most likely towards its pyloric orifice, the progress of which has been materially impeded, with always a great diminution, and occasionally a total loss, of pain for a considerable space of time. His comforts have, therefore, been greatly increased, and the approach of the infirmities of age procrastinated by the use of the bismuth. It is here worthy of remark, that the long-continued use of this medicine is productive of no bad consequences, as is the case with some remedies which produce temporary and beneficial effect, but whose continued exhibition becomes injurious to health. Care should be taken to have the white oxide of bismuth quite pure, as it is apt to be mixed with noxious ingredients in its native state before it is reduced to an oxide.

Queen Street, May Fair,
Dec. 18, 1819.

ART. XIV. *On a new Hygrometer, which measures the Force and Weight of aqueous Vapour in the Atmosphere, and the corresponding Degree of Evaporation. By* J. F. Daniell, Esq. F.R.S. *and* M.R.I.

IN the year 1812, my attention having been accidentally directed to the deposition of moisture which takes place upon certain bodies, when brought into an atmosphere which is warmer than themselves, the idea occurred to me, that the fact was connected with meteorological phenomena; and that experiments founded upon it, might be devised to elucidate the relation of air to vapour. I shortly after applied myself seriously to the inquiry, and was soon satisfied that I had not been deceived in my conjecture. The manner in which I proceeded at

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that time was shortly this: I made a mixture of two salts, calculated to produce cold by their solution; I then arranged half a dozen drinking-glasses upon a board, each furnished with a thermometer, and poured water into one of them. I added a tea-spoonful of the freezing mixture, which invariably produced a copious dew upon the exterior of the glass. I poured the contents of the first glass into the second, and so into the third, till the liquor, gradually acquiring heat by the process, arrived at such a temperature as no longer to produce any condensation upon the vessel. This point, as marked by the thermometer, was accurately noted, and was found to vary very considerably, according to the different states of the atmosphere. I kept a journal of the weather several months, registering the variations of the barometer, thermometer, De Luc's hygrometer, and the highest degree of the thermometer, at which moisture was condensed, and obtained some very interesting results. I afterwards varied my apparatus in the following manner: I procured five small brass hollow cylinders, three inches in diameter and four inches in height, fitted with a small cock in the bottom of each. These were very highly polished, and placed in a frame, one immediately over another, so that by turning the cock, the contents of the upper would flow into that directly beneath it. I put the cold liquid into the top bucket; and when steam was produced upon its surface, suffered the solution to run into the next, and so into the third, till all condensation ceased, when the temperature was marked as before. I found this apparatus very sensible; the bright surface of the metal being visibly obscured by the slightest film of moisture. These experiments were, however very troublesome, and required much time to ensure accuracy. The results I forbear from particularly detailing, as they are superseded by the more accurate observations which I have been enabled to make with the instrument which I am about to describe.

It was not till many months after I had commenced this course of inquiry, that I discovered that the idea which had occurred to me, was not as new as I had conceived it to be. I found that Mr. Dalton, in his "Essay upon the force of steam or vapour, from

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water and other liquids, at different temperatures," (one of an interesting series, read before the Literary and Philosophical Society of Manchester, and published in the fifth volume of their Memoirs, which it would be difficult to match for originality, and sound philosophical induction,) thus describes his method of finding the force of the aqueous atmosphere:—"I usually take a tall cylindrical glass jar, dry on the outside, and fill it with cold spring-water fresh from the well; if dew be immediately formed on the outside, I pour the water out; let it stand awhile to increase in heat, dry the outside of the glass well with a linen cloth, and then pour the water in again: this operation is to be continued till dew ceases to be formed, and then the temperature of the water must be observed. Spring-water is generally about 50°, and will mostly answer the purpose the three hottest months of the year: in other seasons an artificial cold mixture is required."

However flattered I might have been by any coincidence of opinion with so able a philosopher, the discovery of want of originality damped for a time the ardour of pursuit; but I have ever since been impressed with the utility of any contrivance, which should enable an observer to mark with precision and expedition the constituent temperature of atmospheric vapour. Upon reading the account of the ingenious contrivance of Dr. Wollaston, which he has termed the Cryophorous, the subject again occurred to me, and I received from that instrument the hint which, after many trials, led to the completion of my hygrometer.

Plate 5, fig. 1, represents the instrument in its full dimensions. *A.* and *b.* are two thin glass-balls of 1¼ inch diameter, connected together by a tube, having a bore of about ⅛th of an inch. The tube is bent at right angles over the two balls, and the arm *b. c.* contains a small thermometer, *d. e.*, whose bulb, which should be of a lengthened form, descends into the ball *b.* This ball, having been about two-thirds filled with ether, is heated over a lamp till the fluid boils, and the vapour issues from the capillary tube *f.*, which terminates the ball *a.* The vapour having expelled the air from both balls, the capillary

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tube *f.* is closed hermetically by the flame of a lamp. This process is well known to those who are accustomed to blow glass, and may be known to have succeeded, after the tube has become cool, by reversing the instrument and taking one of the balls in the hand, the heat of which will drive all the ether into the other ball, and cause it to boil rapidly. The other ball *a.* is now to be covered with a piece of muslin. The stand *g. h.* is of brass, and the transverse socket *i.* is made to hold the glass-tube, in the manner of a spring, allowing it to turn and be taken out with little difficulty. A small thermometer *k. l.* is inserted into the pillar of the stand.

The manner of using the instrument is this: After having driven all the ether into the ball *b.* by the heat of the hand, it is to be placed in an open window, or out of doors, with the ball *b.* so situated as that the surface of the liquid may be upon a level with the eye. A few drops of ether are then to be poured upon the covered ball. Evaporation immediately takes place, which producing cold upon the ball *a.* causes a rapid and continuous condensation of the ethereal vapour in the interior of the instrument. The consequent evaporation from the included ether produces cold in the ball *b.*, the degree of which is measured by the thermometer, *d. e.* This action is almost instantaneous. The thermometer begins to fall in two seconds after the ether has been dropped. A depression of 30 degrees is easily produced, and I have seen the ether boil, and the thermometer driven down below 0° of Fahrenheit's scale. The artificial cold thus produced causes a condensation of the atmospheric vapour upon the ball *b.*, which first makes its appearance in a thin ring of dew coincident with the surface of the ether. The degree at which this takes place is to be carefully noted. A little practice may be necessary to seize the exact moment of the first deposition, but certainty is very soon acquired. It is advisable to have some dark object behind the instrument, such as a house or a tree, as the cloud is not so soon perceived against an open horizon. The depression of temperature is first produced at the surface of the liquid where evaporation takes place, and the currents which immediately ensue to restore the equi-

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librium, are very perceptible. The bulb of the thermometer *d. e.* is not quite immersed in the ether, that the line of greatest cold may pass through it. The greatest difference that I have observed in the course of four months' daily experiments between the external thermometer *k. l.* and the internal one *e. d.* at the moment of precipitation in the natural state of the atmosphere, was 20 degrees. In very damp weather the ether should be slowly dropped upon the ball, otherwise the descent of the thermometer is so rapid as to render it impossible to be certain of the degree. In dry weather on the contrary, the ball requires to be well wetted more than once, to produce the requisite degree of cold. It is almost superfluous to observe, that care should be taken not to permit the breath to affect the glass. With these precautions the observation is simple, easy and certain.

When the instrument is required to act merely as a weather-glass, to predict the greater or less probability of rain, &c., which is the commonest use to which it can be applied, the difference between the constituent temperature of the vapour, and that of the air, is all that is necessary to be known. The probability of rain or other precipitation of moisture from the atmosphere, is in inverse proportion to this difference. The journal of observations annexed will prove that for this purpose it is more to be depended upon than any instrument that has yet been proposed. For example, upon reference to the Table it will be found, that on the 29th of August the barometer fell continually all the day, as it had done all the day before. The hygrometer, however, shewed the great elasticity of the vapour, and its little inclination to deposition. The difference of the temperatures varied from 13° to 17°, and there was no rain. The next day the barometer continued to fall. In the morning, which was fine, the difference had fallen to 10°, and in the afternoon to 2°. Heavy showers ensued, which were not however of long continuance. On the 3d of September, the barometer rising the whole day, the hygrometer denoted rain, which came down in heavy showers in the evening. On the 29th and 30th of the same month, the

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barometer and hygrometer were at variance, and the result was in favour of the latter. On the 30th and 31st of October, during an uninterrupted rise of the barometer of 0.32 inches, the hygrometer denoted the utmost point of humidity, and much rain fell during the period.

By combining the observations of both instruments, we learn to modify their results, and by so doing can hardly be deceived in the weather for many hours in advance. The indications are to be corrected according to circumstances in the following manner:—In summer-time when the diurnal variations of temperature are great, regard is to be had to the time of day at which the experiment is made. In the morning, supposing the difference between the temperature of the air and the constituent temperature of the vapour to be small, it is to be recollected, that the accession of heat during the day is great, and that the difference will therefore probably increase. If the point of condensation should at the same time be lowered, it is an indication of very fine weather. If, on the contrary, the heat of both should increase with the day in nearly equal progression, rain will almost infallibly follow, as the heat of the air falls with the setting sun. Thus, on the 14th of September, at nine o'clock in the morning, the temperature of the air was 62°, the point of condensation 57°, making a difference of 5°. At three o'clock the heat of the air had risen 10°, and the point of condensation had fallen 2°, making a difference of 17°. The day was nearly cloudless. At seven o'clock the heat of the air had fallen to 66°, and at ten o'clock to 61°. The temperature of the vapour at the same time rose 2°. The night was very clear, but there was a great deposition of moisture upon dry wood, slates, *&c.* The 15th of the same month afforded an instance of the contrary case. The morning observation shewed a difference of 7°, the point of condensation having at the same time risen during the night: the heat of the day increased, but accompanied by a rapid rise in the constituent temperature of the vapour, from 59° to 65°. The consequence was rain, which increased in quantity as the sun declined. In winter, however, when the range of the thermometer during the

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day is very small, the indication of the weather must be taken more from the actual rise and fall of the point of condensation, than from the difference between it, and the temperature of the air. In showery weather the indications of the instrument vary rapidly three or four degrees, and a person making observations at short intervals of time, may easily predict the approach of a storm. On the 30th of August I had occasion to make a great many experiments in the course of the day, which was marked by many heavy showers. The morning was fine, and the first observation marked the point of precipitation 10° below the temperature of the air. In half an hour after it was only 6°. At the interval of another half hour, it had again returned to 10°. During this period a very heavy cloud passed, and although there was no rain at the place of observation, I afterwards found that a smart shower had fallen within a thousand paces. Subsequent observations gave a difference of only 2°. Slight showers also fall sometimes in summer, without affecting the hygrometer, but they are of very short continuance, and probably come from very lofty regions. They are rather indications of fine weather than the contrary.

Fogs also and mists must be taken into consideration. They produce the same effect upon the instrument as the greater precipitations of rain. Thus, on the evenings of the 15th and 18th of October, the hygrometer shewed the utmost point of humidity during the fogs which prevailed, while the great fall in the degree of condensation shewed that the effect would not be great or lasting. A change from fine weather to rain is more quickly perceptible in low situations than one from wet to fine, for the effect of a shower lasts rather longer than the state of the atmosphere in higher regions would warrant, on account of the damp exhalations from the moistened ground.

Winds, moreover, sometimes produce an effect before their influence is pointed out by other indications. Many instances occur in the journal in which a change of wind has affected the hygrometer before it has changed the direction of a weathercock, or even the course of smoke. Thus, on the 3d

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of September, it will be seen that a very remarkable rise in the temperature of the vapour preceded by many hours the change of the wind, on the 4th, from N.W. to S.W. A gradual fall on the 20th of October preceded the change of the wind from S.W. to N.W. on the 21st. The southern and western sea-breezes bear with them a very different proportion of vapour to that of the northern and eastern land breezes. The reason why the aqueous particles may appear to precede the wind, I shall endeavour to discuss in a future paper, together with some other points of theory, on which I think the present detail of facts and experiments may throw some light. In cases of mist, fog, and cloud, the instrument will sometimes exhibit a different kind of action. If it be brought from an atmosphere of a higher temperature into one of a lower degree, in which condensed aqueous particles are floating, the mist will begin to form upon the ball at a temperature several degrees higher than that of the air. The difference, I believe, is proportionate to the density of the cloud or mist; but I speak with diffidence upon this point, as I have not had sufficient opportunities of verifying it by experiment. I have sometimes thought, that I have perceived a difference in this respect, in different modifications of the cloud, but this must be referred to future more extended observations. This action upon floating water does not at all interfere with it as measuring the force and quantity of vapour, for in all such cases the full saturation of the atmospheric temperature must have place, and consequently the temperature of the vapour must be coincident with that of the air.

But although the hygrometer which I am now describing excels all others, I believe, in sensibility, and the accuracy with which it marks the comparative degrees of moisture and dryness in the atmosphere, and, by exhibiting them in degrees of the thermometer, refers them to a known standard of comparison, and speaks in a language which every body understands, yet it is not upon this alone that I venture to found its claims of superiority. Its great merit consists in indicating with ease and precision the positive weight of aqueous gas

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diffused through any given portion of space, and the force and elasticity of vapour, as measured by the column of mercury which it is capable of supporting. The means of finding these with ease and precision are furnished by the annexed Table, upon the construction of which it will be necessary to subjoin a few remarks.

TABLE I.—*Shewing the Force, Density, and Expansion, of Aqueous Vapour, at different Degrees of Temperature, from* 0° *to* 92°.

Temperature.	Force.	Weight of a Cubic Foot.	Expansion.
Fahrenheit.	Inches of Mercury.	Grains.	
0°	0.064	0.789	1.000
1	0.066	0.812	1.002
2	0.068	0.835	1.004
3	0.071	0.870	1.006
4	0.074	0.906	1.008
5	0.076	0.928	1.000
6	0.079	0.963	1.012
7	0.082	0.997	1.014
8	0.085	1.032	1.016
9	0.087	1.054	1.018
10	0.090	1.089	1.020
11	0.093	1.123	1.022
12	0.096	1.156	1.024
13	0.100	1.202	1.027
14	0.104	1.247	1.029
15	0.108	1.292	1.031
16	0.112	1.337	1.033
17	0.116	1.411	1.035
18	0.120	1.428	1.037
19	0.124	1.474	1.039
20	0.129	1.529	1.041
21	0.134	1.586	1.043
22	0.139	1.642	1.045
23	0.144	1.698	1.047
24	0.150	1.763	1.050
25	0.156	1.831	1.052
26	0.162	1.897	1.054
27	0.168	1.959	1.056
28	0.174	2.030	1.058
29	0.180	2.096	1.060
30	0.186	2.162	1.062
31	0.193	2.240	1.064
32	0.200	2.317	1.066

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TABLE I.—*continued.*

Temperature.	Force.	Weight of a Cubic Foot.	Expansion.
Fahrenheit.	Inches of Mercury	Grains.	
33	0.207	2.393	1.068
34	0.214	2.438	1.070
35	0.221	2.545	1.072
36	0.229	2.629	1.075
37	0.237	2.717	1.077
38	0.245	2.803	1.079
39	0.254	2.900	1.081
40	0.263	2.999	1.083
41	0.273	3.106	1.085
42	0.283	3.214	1.087
43	0.294	3.326	1.089
44	0.305	3.452	1.091
45	0.316	3.570	1.093
46	0.328	3.699	1.095
47	0.339	3.815	1.097
48	0.351	3.940	1.100
49	0.363	4.068	1.102
50	0.375	4.195	1.104
51	0.388	4.330	1.106
52	0.401	4.468	1.108
53	0.415	4.616	1.110
54	0.429	4.770	1.112
55	0.443	4.910	1.114
56	0.458	5.068	1.116
57	0.474	5.235	1.118
58	0.490	5.402	1.120
59	0.507	5.570	1.124
60	0.524	5.761	1.125
61	0.542	5.950	1.127
62	0.560	6.126	1.129
63	0.578	6.310	1.131
64	0.597	6.506	1.133
65	0.616	6.614	1.135
66	0.635	6.912	1.137
67	0.655	7.013	1.139
68	0.676	7.316	1.141
69	0.698	7.541	1.143
70	0.721	7.776	1.145
71	0.745	8.027	1.147
72	0.770	8.270	1.150
73	0.796	8.533	1.152
74	0.823	8.807	1.154
75	0.851	9.091	1.156
76	0.880	9.385	1.158

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TABLE I.—*continued.*

Temperature.	Force.	Weight of a Cubic Foot.	Expansion.
Fahrenheit.	Inches of Mercury	Grains.	
77	0.910	9.688	1.160
78	0.940	9.992	1.162
79	0.971	10.292	1.164
80	1.000	10.591	1.166
81	1.040	10.993	1.168
82	1.070	11.293	1.170
83	1,100	11.590	1.172
84	1.140	11.981	1.175
85	1.170	12.252	1.177
86	1.210	12.681	1.179
87	1.240	12.966	1.181
88	1.280	13.368	1.183
89	1.329	13.756	1.185
90	1.360	14.150	1.187
91	1.400	14.542	1.189
92	1.440	14.931	1.191
212	30.000	257.119	1.441

Mr. Dalton, in his valuable Essay before referred to, has detailed the results of a laborious series of experiments, by which he ascertained, with precision, the force of vapour from water, at every degree between its freezing and boiling points; and has extended the observations by an ingenious calculation to every temperature from that of the congelation of mercury to 325° of Fahrenheit's scale. These results, as far as is necessary to the present purpose, I have adopted, and the second column of the table exhibits the force of aqueous vapour, in inches of mercury at the temperature opposed to it in the first column. Upon these two *data*, namely, the force and temperature of the vapour, are founded the calculations, which have furnished me with the series of the third column, which contains the weight in grains of a cubic foot of the vapour at the corresponding temperature and pressure. The method of proceeding is this: Steam at 212°, and under a pressure of 30 inches of mercury, is, as nearly as possible 1700 times lighter than an equal bulk of water. A

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cubic foot of water at its maximum of density, weighs 437102.4946 grains. The weight, therefore, of a cubic foot of steam at the above temperature and pressure, is $\frac{437102.4946}{1700}$ or 257.1191 grains. From hence we may find the weight of an equal bulk of vapour of the same temperature, under any other given pressure, suppose 0.524 : for the volume being in inverse proportion to the pressure

$$\overset{\text{Ins.}}{30.} : \overset{\text{Ins.}}{0.524} :: \overset{\text{Grs.}}{257.119} : \overset{\text{Grs.}}{4.491}$$

the weight required.

Having now obtained the weight of a cubic-foot of vapour, at a pressure of 0.524, and at a temperature of 212°, we may proceed to find its weight under the same pressure, at any other temperature, suppose 60°. The gasses, it will be remembered, expand $\frac{1}{480}$ part of their volume for every accession of heat, equal to 1° of Fahrenheit's scale; therefore reckoning as unity a volume of gas at 0°, its volume at 60° is to its volume at 212° as $1+\frac{60}{480}$ is to $1+\frac{212}{480}$, or : : 1.125 : 1.441, therefore the density and weight being in inverse proportion to the volume

$$\overset{\text{Ins.}}{1.125} : \overset{\text{Ins.}}{1.441} :: \overset{\text{Grs.}}{4.491} : \overset{\text{Grs.}}{5.628}$$

the weight of a cubic-foot of vapour at the temperature of 60°, and a pressure of 0.524 inches.

It must be further remembered, that it has been proved by Mr. Dalton, that as much vapour of determined temperature is formed in a given bulk of air, as in a vacuum of equal space; therefore the above result gives the weight of vapour, which can exist in a cubic foot of the air at the temperature of 60°. The fourth column of the table contains the proportionate expansion for the corresponding degrees.

The calculations for these several series have been made to the third place of decimals, which will be sufficiently accurate for all common purposes. The manner of using the table will be best understood from an example.

Let the temperature of the atmosphere be 70°; and the point of condensation, as found by the hygrometer, 55°; the pressure of the vapour under these circumstances, is immediately found opposite to the degree of its constituent heat 55° 0.443. To find its weight, we proceed thus:—supposing as much as pos-

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sible to exist in the space of a cubic foot, its weight would be found upon the same line as its pressure, 4.910grs. But its bulk is expanded by the existing temperature of the air; therefore we must seek in the fourth column for the degree of expansion, at 55° 1.114, and at 70° 1.145, and apply the correction thus;—

Bulk at 70°. Bulk at 55°. Grs. Grs.

1.145 : 1.114 :: 4.910 : 4.777

the weight required.

Now the state of the atmosphere, assumed above, would constitute fine weather, and one of two things, or a modification of both, must happen before any precipitation of water could take place; either the temperature of the air must fall below 55°, or the quantity of vapour must increase to 7.776grs. in the cubic foot, the maximum quantity that could exist at 70°, or the point of condensation might become intermediate, by a corresponding rise and fall of the two.

In the first case, the precipitation would probably be only slight and transitory, such as mist, fog, or small rain. In the second case, it would assume the form of hard rain and storms; while in the third, some conjecture might be formed of its probable duration and quantity, according as one or other of its causes prevailed.

But the hygrometer can be made to measure, not only the quantity and force of vapour existing at any time in the air, but also, it may be applied to indicate the force and quantity of evaporation. Mr. Dalton, in the course of that important train of investigation to which I have before had occasion to refer, ascertained that the quantity of water evaporated in a given time, bore an exact proportion to the force of vapour at the same temperature. The atmosphere obstructs its diffusion, which would otherwise be almost instantaneous, as in vacuo, but this obstruction is overcome in proportion to the force of the vapour. The obstruction, however, does not arise from the weight of the atmosphere, for that would prevent any vapour from arising under 212°; but, as Mr. Dalton observe, is caused by the *vis inertiæ* of the particles of air, and is similar to that which a stream of water meets with in descending amongst pebbles. In ascertaining this point at ordinary atmospheric

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temperatures, regard must be had to the force of vapour already existing in the air. For instance, if water of 59° were the subject, the force of vapour of that temperature is $\frac{1}{60}$ of the force at 212°, and one might expect the quantity of evaporation to be $\frac{1}{60}$ also; but if it should happen, that an aqueous atmosphere to that amount does already exist, the evaporation, instead of being $\frac{1}{60}$ of that from boiling water, would be nothing at all. On the other hand, if the aqueous atmosphere were less than that, suppose half of it, then the effective evaporating force would be $\frac{1}{120}$ of that from boiling water; in short, the evaporating force must be universally equal to that of the temperature of the water, diminished by that already existing in the atmosphere.

But the air, by its mechanical action, has another influence upon the rate of evaporation. When calm and still, it merely obstructs the process; but when in motion, it increases its effect in direct proportion to its velocity, by removing the vapour as it forms. Mr. Dalton fixes the extremes that are likely to occur in ordinary circumstances at 120 and 189grs. per minute, from a vessel of six inches diameter, at a temperature of 212°.

Upon these data, he has constructed the following Table:—

TABLE II.—*Shewing the Force of Vapour, and the full evaporating Force of every Degree of Temperature, from* 20° *to* 85°, *expressed in Grains of Water that would be raised per Minute from a Vessel of six Inches in Diameter, supposing there were no Vapour already in the Atmosphere.*

Temperature.	Force of Vapour.	Evaporating Force in Grains.		
212°	30.	120.	154.	189.
20	0.129	0.52	0.67	0.82
21	0.134	0.54	0.69	0.85
22	0.139	0.56	0.71	0.88
23	0.144	0.58	0.73	0.91
24	0.150	0.60	0.77	0.94

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TABLE II.—*continued.*

Temperature.	Force of Vapour.	Evaporating Force in Grains.		
212°.	30.	120.	154.	189.
25	0.156	0.62	0.79	0.97
26	0.162	0.65	0.82	1.02
27	0.168	0.67	0.86	1.05
28	0.174	0.70	0.90	1.10
29	0.180	0.72	0.93	1.13
30	0.186	0.74	0.95	1.17
31	0.193	0.77	0.99	1.21
32	0.200	0.80	1.03	1.26
33	0.207	0.83	1.07	1.30
34	0.214	0.86	1.11	1.35
35	0.221	0.90	1.14	1.39
36	0.229	0.92	1.18	1.45
37	0.237	0.95	1.22	1.49
38	0.245	0.98	1.26	1.54
39	0.254	1.02	1.31	1.60
40	0.263	1.05	1.35	1.65
41	0.273	1.09	1.40	1.71
42	0.283	1.13	1.45	1.78
43	0.294	1.18	1.51	1.85
44	0.305	1.22	1.57	1.92
45	0.316	1.26	1.62	1.99
46	0.327	1.31	1.68	2.06
47	0.339	1.36	1.75	2.13
48	0.351	1.40	1.80	2.20
49	0.363	1.45	1.86	2.28

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TABLE II.—*continued.*

Temperature.	Force of Vapour.	Evaporating Force in Grains.		
212°.	30.	120.	154.	189.
50	0.375	1.50	1.92	2.36
51	0.388	1.55	1.99	2.44
52	0.401	1.60	2.06	2.51
53	0.415	1.66	2.13	2.61
54	0.429	1.71	2.20	2.69
55	0.443	1.77	2.28	2.78
56	0.458	1.83	2.35	2.88
57	0.474	1.90	2.43	2.98
58	0.490	1.96	2.52	3.08
59	0.507	2.03	2.61	3.19
60	0.524	2.10	2.70	3.30
61	0.542	2.17	2.79	3.41
62	0.560	2.24	2.88	3.52
63	0.578	2.31	2.98	3.63
64	0.597	2.39	3.07	3.76
65	0.616	2.46	3.16	3.87
66	0.635	2.54	3.27	3.99
67	0.655	2.62	3.37	4.12
68	0.676	2.70	3.47	4.24
69	0.698	2.79	3.59	4.38
70	0.721	2.88	3.70	4.53
71	0.745	2.98	3.83	4.68
72	0.770	3.08	3.96	4.84
73	0.796	3.18	4.09	5.00
74	0.823	3.29	4.23	5.17

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TABLE II.—*continued.*

Temperature.	Force of Vapour.	Evaporating Force in Grains.		
212°.	30.	120.	154.	189.
75	0.851	3.40	4.37	5.34
76	0.880	3.52	4.52	5.53
77	0.910	3.65	4.68	5.72
78	0.940	3.76	4.83	5.91
79	0.971	3.88	4.99	6.10
80	1.000	4.00	5.14	6.29
81	1.04	4.16	5.35	6.54
82	1.07	4.28	5.50	6.73
83	1.10	4.40	5.66	6.91
84	1.14	4.56	5.86	7.17
85	1.17	4.68	6.07	7.46

The first column contains the degrees of temperature; the second the corresponding force of vapour; the third the amount of evaporation per minute, from a vessel of six inches diameter, in calm weather; the fourth the amount in a moderate breeze; and the fifth in a high wind.

The use of this table as applied to the hygrometer is this: let it be required to know the force of evaporation at the existing state of the atmosphere. Find the point of condensation by the instrument as before directed. Subtract the grains opposite that temperature, either in the third, fourth, or fifth columns, according to the state of the wind, from the grains opposite to the temperature of the air in the same column, and the remainder will be the quantity evaporated in a minute, from a vessel of six inches diamteer, under the given circumstances. For example;—let the point of condensation be 52°, the tem-

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perature of the air 65°, with a moderate breeze. The number opposite 52° in the fourth column is 2.06, and that opposite 65° is 3.16; the difference 1.1 grain, is the evaporation per minute.

I shall now proceed to explain the annexed journal of my observations upon the weather, premising that the instruments which I employ are all placed in an eastern aspect, out of the direct rays of the sun, and as much as possible secured from the influence of surrounding objects.

The first, second, and third columns contain the date and hour of the observation, and the moon's age. The fourth exhibits the pressure of the whole atmosphere, as measured by the barometer; and the fifth, the continuous rise and fall of that instrument. The sixth column shows the pressure of the aqueous atmosphere alone: by a comparison of this with the preceding, it will be observed how little the latter has to do with the comparatively great variations of the compound atmosphere. If any connexion can be traced at all, it is rather that the pressure of the vapour increases as the whole diminishes, and *vice versâ*, than the contrary.

The seventh column gives the temperature of the air, at the time of observation; and the eighth, that of the vapour or the point of condensation. The ninth shews the difference between the two. The probability of aqueous precipitations is in inverse proportion to these numbers; and if it should be thought necessary to speak of the indications of the hygrometer in degrees of a scale, these are the numbers which will express those degrees. The extent of the scale, as far as I have observed, is 20°.

The tenth column exhibits the weight of acqueous vapour actually existing in a cubic foot of the atmosphere; the eleventh, the maximum quantity of the same, which might exist if the temperature of the air were to fall to the temperature of the vapour; and the twelfth, the maximum quantity which might exist, if saturation were to take place at the temperature of the air. It will be observed that these three coincide, when precipitation is actually taking place. From their approximation

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arises the probability of falling weather: and, according as it happens, by the fall of the temperature of the air, or by the rise of the constituent temperature of the vapour, so is the probability of its less and greater quantity, its shorter or longer continuance. The thirteenth and fourteenth columns contain the *maximum* and *minimum* of temperature in the course of the twenty-four hours, as marked by a register thermometer. The fifteenth column shews the lowest temperature of a thermometer laid upon the ground during the night, with its bulb covered with dark wool. The late Dr. Wells, in his admirable *Essay upon Dew*, has shewn that the quantity of that nocturnal precipitation of moisture upon different bodies is *cæteris paribus* proportionate to the quantity of heat which they radiate to the sky. My object, in this division of my register, is to obtain the lowest temperature of a good radiator, and of one that approaches nearly to the nature of grass and other vegetables in that particular; as the knowledge of this point, connected with that of the actual quantity of vapour in the air, may furnish data upon which to form an estimate of the actual amount of the aqueous deposition. As connected with this subject, I may here remark, that the average temperature of the morning vapour exceeds that of the night by about 1°, making a difference in quantity of about 0.138 grain in the cubic foot less in the night than in the morning. The sixteenth column registers the quantity of rain at different periods.

The seventeenth contains an account of the variations of a De Luc's hygrometer. This I have extracted from the *London Medical Repository*. It is furnished by Messrs. Harris and Co., of Holborn; and, on account of the vicinity of the places of observation, will very well answer my purpose. It is perhaps, upon the whole, the best instrument of the kind that was ever invented, and it will be seen how vague and indecisive its indications are.

The eighteenth column shews the force of evaporation in the number of grains which would rise in one minute from a vessel of six inches diameter.

The direction of the wind is exhibited by the nineteenth

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column, and its force very imperfectly by the twentieth. Upon an average of experiments, I find that the winds from the NW. N. NE. and E., contain 1½ grain less of vapour in a cubic foot than those which blow from the SE., S., SW., and W.

In the twenty-first column I have endeavoured to describe the prevailing modifications of clouds, in the nomenclature of Mr. Howard. Some idea of the height of the lowest beds of these aqueous condensations may perhaps be formed from the indications of the hygrometer. An elevation of about 530 feet causes a fall in the thermometer of 1° of Fahrenheit's scale; therefore, knowing the point of condensation, and the temperature of the air, if we multiply the difference by 530, we shall obtain an approximation to the height of the first clouds which can form, by the ascent of the vapour.

The twenty-second column closes the table with some general observations.

Plate 4, represents the comparative rise and fall of the barometer and hygrometer, and of the temperature of the air and vapour, taken at morning and evening, during the period of the journal. The two former are laid down upon the same scale, and the upper lines represent the real proportionate difference of the simple and compound pressure. It will be observed how much greater the variation of the vapour is for one degree at the higher part of the thermometric scale, than it is for one degree at the lower. The lower lines depict the variations of temperature; the continuous one, that of the atmosphere; the dotted that of the point of condensation. In fine weather, it will be observed that these two are widely separated, while, during the time of aqueous precipitation, they coincide. The converging lines shew the direction of the wind.

It has ever been a favourite speculation with philosophers to trace, in the constitution of the atmosphere, the origin of some of the diseases which affect the human race. The discovery of pneumatic chemistry, and the new means of questioning nature, which it put into their hands, seemed, at first, to promise a solution of this interesting problem, and hopes were entertained that the cause of epidemic and local complaints might be found in

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the varying elements of the compound air we breathe. The eudiometric processes which were immediately instituted and repeated in every part of the world, proved, however, the unvarying proportions of the permanent gases of which it is composed. May we not indulge an expectation, that an accurate method of estimating the varying quantity of aqueous vapour in the elastic medium which surrounds us, which is the only fluctuating ingredient of its composition, may lead to some useful hints upon this important subject? Certain it is, that some indications of this kind may be perceived, even by the healthy, and those who are not conversant with the progress of disease. There are days when even the most robust feel oppression and languor, which are commonly and justly attributed to the weather; while, on others, they experience exhilaration of spirits, and an accession of muscular energy. Some such days I have endeavoured to mark in the journal of observations.

The 3d of September was particularly oppressive, close, and relaxing. The temperature of the air was 68°, and the hygrometer marked the point of condensation at 65°, indicating upwards of 6¼ grains of vapour in the cubic foot. Evaporation was next to nothing. Rain ensued, and the atmosphere was relieved. On the 6th of September, the temperature of the air was within 2° as high as on the 3d, but the point of condensation was 20° below, and the quantity of vapour in the cubic foot was very little more than 3½ grs. The day was fresh and exhilarating. On the 7th, the quantity had again increased to nearly its former point, accompanied by the same effect upon the feelings.

On the 20th of November, there was very little more than two grains of vapour in a cubic foot of the air. The atmospheric temperature was 35°, but the cold was very cutting, and very much beyond what was indicated by the thermometer, on account of the great dryness which prevailed. The oppression of sultry days may be accounted for, from the obstruction of the insensible perspiration of the body, which is prevented from exhaling into the atmosphere, already surcharged with moisture; while unimpeded transpiration from the pores, when the air is more free from aqueous vapour, adds new energy to

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all the vital functions. In bodies debilitated by disease, indeed, the contrary effects may be produced. They may be unable from weakness, to support the drain of free exhalation, which is exhilarating to the healthy; and hence, probably, arises the benefit of mild climates and warm sea breezes, in cases of consumption and diseases of the lungs. Observations of the hygrometer in places which have been found of service in those complaints, will, not improbably, throw some light upon their treatment; and may, perhaps, teach us to construct an artificial atmosphere of greater efficacy than any that has yet been recommended on occasions when the relief of local change may be impossible. Observations also in marshy and fenny situations may not unreasonably be expected to explain the diseases prevalent in such districts, and an extension of the use of the instrument to different countries, cannot fail to elucidate many, as yet obscure, peculiarities of situation and climate.

I shall now proceed to describe the manner of applying the hygrometer to artificial atmospheres, and to detail some experiments with it, detached from the preceding series. *Plate 5. Fig.* 2, represents a bell-glass, prepared for this purpose. A hole is drilled in its side, through which the tube, proceeding from the ball placed under it, containing the thermometer, is passed, and welded with the tube proceeding from the other ball on its exterior side, by means of a lamp; the stem is then secured in the side of the glass by means of a cement, and the ether boiled, and the capillary opening secured as before directed. The exterior ball is then to be covered with muslin. In this way the evaporation from the latter produces a corresponding degree of cold upon the ball under the bell-glass, and will measure the quantity of vapour included, by the precipitation which may readily be marked. The bell-glass may be secured by grinding, and other well known means, from any communication with the exterior air.

The hygrometric properties of any substance may thus be easily measured, by placing it under the receiver, and marking the absorption of the vapour.

Exp. 1. With the thermometer at 60°, I found the point of

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condensation at 50°. I then took a receiver, fitted with a hygrometer, whose capacity was fifty-six cubic inches, and ground to the plate of the air-pump. The condensation was produced very visibly under the glass at the same temperature. Now, the quantity of vapour in a cubic foot of the air, under the above conditions, was only 4.116 grains; therefore, the quantity actually included in the receiver, could only be 0.133 grains, which will serve to prove the extreme delicacy of the instrument, as it distinctly indicated so small a quantity. The receiver was then slid over a vessel containing water. In an hour and a half, the external temperature remaining the same, the precipitation took place at 57°. At the expiration of another hour and a half, the affusion of the ether upon the exterior ball caused instantaneous condensation upon the interior, shewing that saturation at the existing temperature had taken place. The bell-glass was now slid from the water without changing its contents, and placed over a glass, containing a few drops of sulphuric acid. After remaining a quarter of an hour in this situation, a depression of temperature of 30° produced no mist upon the instrument.

Exp. 2. The receiver was placed upon the plate of the air-pump, with some water under it. The air was then exhausted as perfectly as possible. The barometer stood at 29.79, the thermometer at 62°, the gauge of the pump at 29.20; to the latter should be added, the pressure of the included vapour, at 62°—0.560, which would make the gauge and the barometer correspond within 0.03. When ether was dropped upon the exterior ball, precipitation was instantaneous. Air was now admitted gradually till the gauge fell to 14. The point of condensation was not altered, neither was it affected by restoring the equilibrium completely.

Exp. 3. Temperature 64°, point of condensation 61°. The air in the receiver was rarefied till a copious cloud was formed. The gauge then stood at 8.1, the point of condensation had fallen to 54°. When the glass had risen to 60°, the air was suddenly restored, and a copious dew was formed upon it; the exhaustion was next carried on till the cloud had totally disap-

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peared, and the gauge stood at 24.2. No precipitation took place at a temperature of 34°; the air was gradually re-admitted, and the deposition took place with the hygrometer at 36°, and the gauge at 15° *.

Exp. 4. The receiver was filled with oxygen, in contact with water, and afterwards with hydrogen; but the point of condensation was the same as when filled with common air, under the same circumstances. This, and Experiment 2, fully coincide with Mr. Dalton's view of the theory of mixed elastic fluids, and prove, indeed, that the gases are as *vacua* with regard to vapour; and that, where they happen to be mixed together, they exist as independent atmospheres.

Exp. 5. Having absorbed all the vapour contained in the receiver, by means of sulphuric acid, I placed it over some spirits of wine. After remaining some hours in this situation, a few drops of ether upon the external ball produced an instant condensation upon the internal one. The experiment was repeated with ether in the place of the spirits of wine, with the same results.

Exp. 6. The temperature of a room being 45°, I found the point of condensation in it to be 39°. A fire was lighted, the door and windows carefully shut, and no one allowed to enter. The thremometer rose to 55°, but the point of condensation remained the same. A party of eight persons afterwards occupied the room for several hours, and the fire was kept up. The temperature increased to 58°, and the point of condensation rose to 52°.

Exp. 7. Being desirous of ascertaining, as perfectly as circumstances would allow, the effect of height, as regarding the vapour in the atmosphere, I made a series of observations in the exterior iron gallery of St. Paul's, in different states of the weather, of which the following are the results. They are arranged for convenience in the tabular form.

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* In delicate experiments of this kind, a lighted taper in a glass lantern placed behind the bulb of the instrument, renders the deposition more easily visible, and ensures accuracy.

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TABLE III.

Date.	St. Paul's.			Gower-St.			
	Temperature of		Difference.	Temperature of		Difference.	
	Air.	Vapour.		Air.	Vapour.		
Sep. 27	62	60	2°	63	60	3°	Very showery—night stormy.
Oct. 1	68	61	7	68	63	5	Close and fine—cloudy during the observation—night perfectly fine.
8	63	59	4	64	61	3	Overcast & close—small rain in the night.
9	60	54	6	61	57	4	Ditto ditto.
12	73	61	12	70	63	7	Fine, but misty—fog.
13	65	58	7	63	59	4	Heavy deposition of fog—night fine.
14	58	54	4				Immediately after a shower.
	58	51	7	60	56	4	Quarter of an hour after—dull and heavy.
15	59	44	15	56	45	9	Beautiful day—foggy night.
16	51	38	13	51	39	12	Dull day—night fine.
25	43	32	11	42	35	7	Day fine—night foggy.
26	44	31	13	42	35	7	Day fine—night fine.
27	43	40	3	43	43	—	Small rain—night dull.
28	43	37	6	43	41	2	Frost and Fog—night overcast.
29	41	39	2	42	42	—	Light rain and fog—night windy.
30	43	43	—	43	43	—	Rain all day and night.
Nov. 1	64	45	1	47	46	1	Rain—night overcast.
2	46	42	4	43	34	9	Fine.
24 11 *a.m.*	33	27	6	27	25	2	Hoar frost.
3 p. *m.*	39	34	5	36	33	3	Great deposition of frozen moisture.
Mean	° 51.9	° 45.5	° 6.4	° 50.7	° 46.3	° 4.4	

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From these it will be observed, that, at the period of the observations, the temperature upon the top of St. Paul's, contrary to the generally received opinion, was, upon the average, 1°.2 higher than at the bottom. I no sooner perceived this, than I placed a register thermometer there, and compared it with one placed as nearly as possible under similar circumstances below. The temperature of the first was often 6° higher than that of the second, and the mean of all the observations was 2°.9 warmer. The mean point of condensation was 0°.9 lower above than below, and the mean difference between the temperature of the air and that of the vapour 2°. greater. The peculiarities of the season when these experiments were tried, must be taken into the account. Fogs and hoar-frost were very prevalent. The surface of the earth was cooled by nightly radiation, which lowered the temperature of the contiguous air. This influence could extend but a small way, and ice of considerable thickness was often formed on the earth, while the thermometer never once reached the freezing point at the upper station. We herein have the history of a hoar-frost, and the reason of its short continuance. It is only when it has its origin in the upper regions that a frost can be of long continuance; but this is one of the points of theory that I have reserved for my next paper, and I shall therefore say no more upon it at present. The few experiments that I have had it in my power to make at the summit of St. Paul's, sufficiently prove, that a regular series of meteorological observations upon that elevation, compared with one below, would be interesting and instructive.

The last application of the Hygrometer, which I shall point out, is perhaps of superior importance to any of those which we have been considering. I mean the correction which it affords to barometrical measurements. The principle upon which the Barometer is at present applied to the determination of heights, is the gradation of the density of the atmosphere, considered as a homogeneous fluid of uniform composition. The only correction at present applied is an allowance for the disturbing influence of heat by the expansion of the air, and con-

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sequent augmentation of the elevation due to a given difference of atmospheric pressure. But the atmosphere is not in fact of uniform composition; the quantity of aqueous vapour, one of its component parts, varies almost every hour of the day. It is subject to sudden increase, and as sudden diminution: and, in its ascent to higher regions, follows a very different law from that of the permanent elastic fluids. The barometer measures the total pressure of the compound atmosphere, the hygrometer furnishes us with the means of estimating the insulated pressure of that portion of it, which is fluctuating in quantity, and uncertain in composition; by deducting the latter from the former, we bestow upon the problem the necessary condition of its assumed simplicity. In low latitudes this correction is of most particular importance, as the pressure and quantity of the vapour is in some proportion to the heat. For example, Capt. Webb, in his Memoir upon the Measurement of the Himàlaya Mountains, (*Journal of the Royal Institution*, Vol. VI. p. 55,) informs us, that he computed the elevation of a number of stations upon that lofty range, from the observation of a column of mercury, compared with the mean height of the barometer at Calcutta in the same season. Now the thermometer, in the latitude of the latter place, generally ranges throughout the year between 75° and 95°, and often rises to 100°, and sometimes to 110°. We shall, therefore, be probably under the mark in assuming the temperature of Calcutta, during Captain Webb's observation, at 80°. The summits of the Himàlaya mountains are above the limits of perpetual congelation; therefore, we cannot be much in error in fixing the temperature of these higher stations at 32°. We will next suppose that the air at Calcutta was not saturated with moisture, but that the point of condensation was 10° below the temperature of the air, while, on the mountain, it was at its highest limit. The column of mercury which the former would support would be 0.721 in., while that which would counterbalance the latter, would only be 0.200 in., making a difference of 0.521 in. to be deducted from the height of the barometer at the lower station, and amounting to an error of 468 feet in the estimated height of the upper. This, of course, as far as regards

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the Himàlaya measurements, is a very rough calculation, and the amount of the error is probably below the truth; it will however sufficiently demonstrate the nature and importance of the correction. In higher latitudes, and in the winter season, the state of the vapour may more safely be disregarded, for its pressure increases much more rapidly in the higher part of the thermometric scale for every degree of temperature, than it does in the lower; its influence, however, under all circumstanees, is sufficiently great to make it of consequence, when any thing like accuracy is required.

I shall now conclude this paper. No one can be more aware than myself of the incomplete state in which I have presumed to bring forward these observations. More time, and better opportunities, were required to attain that accuracy which is so desirable in experimental inquiries. London, moreover, is perhaps the worst place in the world for meteorological pursuits. Observations upon clouds, dew, and winds are almost precluded, and any comparison of heights is very limited indeed. Knowing, however, that the great value of the instrument which I have contrived, must be derived from the number, extent, and comparison of the experiments to be performed with it, by different observers, in different situations, I have thought it more for the advantage of science to bring it forward at once, trusting to the candour of the learned to allow of the validity of the excuse. In the meantime, I shall continue my observations, and reserve what further I have to say for a future paper in the *Journal*, when time shall have increased their number, and confirmed their conclusions.

The instruments are accurately constructed, and packed in a box for the pocket, by Mr. Newman, Lisle-Street.

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METEOROLOGICAL JOURNAL.

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Consequent rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 lin. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Aug. 29	10		29.78	.....	0.490	71	58	13	5.974	5.402	8.027	..	.	....	....	..	9	1.31	W	brisk	high cirri and low cumuli ..	A very fine hot day—sun rarely obscured.
	2		29.67	.....	0.474	74	57	17	5.071	5.835	8.907	..	..	....	....	..	..	1.80	.....	increasing	.....	
	5		29.64	.....	0.443	71	55	16	4.768	4.810	8.027	..	..	....	....	..	6	1.55	.....	.....	cirri only	
30	9		29.43	.....	0.594	70	60	10	5.689	5.761	7.776	..	..	....	....	..	9	1.00	SW	brisk	cirri and low scudding clouds	A fine morning with some scudding clouds.
	4		29.24	.....	0.548	63	61	2	5.998	5.850	6.310	..	..	....	....	..	..	0.18	.....	.....	.....	Very heavy showers—incessant rain for two hours—cleared up at five.
	7		29.19	— 0.53	0.584	62	60	2	5.740	5.761	6.126	..	..	....	....	..	7	0.13	.....	.....	.....	Night generally overcast.
31	9		29.23	.....	0.305	62	44	18	3.335	3.432	6.126	..	..	....	....	..	5	1.60	NWW	high	ditto ditto and cumuli....	A fine morning with many clouds, and some of them low.
	5		29.36	.....	0.494	63	43	20	3.902	3.326	6.310	..	..	....	....	..	..	1.46	.....	declining	.....	Very light showers at half past six—a shower with a double rainbow.
	7		29.38	.....	0.316	58	45	13	3.462	3.570	5.402	..	..	....	0.06	..	5	0.70	.....	little	dissolving	Night very clear—moon and stars bright.
Sept. 1	9		29.52	.....	0.283	62	42	20	3.084	3.214	6.126	..	46	....	....	..	5	1.38	NW	brisk	high cumuli and scud	A fine morning with few clouds.
	4		29.59	.....	0.283	60	42	20	3.084	3.214	6.126	..	..	....	....	..	..	1.74	.....	high	.....	Much overcast.
	7		29.62	.....	0.283	57	42	15	3.194	3.214	5.295	..	..	....	....	..	3	1.20	.....	.....	.....	Beautiful night—moon and stars very bright.
2	10		29.67	+ 0.48	0.294	63	43	20	3.208	3.326	6.310	..	..	....	....	..	7	1.46	NWW	brisk	cirri and cumuli	Overcast and hazy.
	5		29.67	.....	0.351	67	48	19	3.805	3.940	7.013	68	60	....	....	..	8	1.57	.....	declining	cumulo strati	Rain in the night.
3	9		29.59	— 0.08	0.616	68	65	3	6.579	6.814	7.316	..	..	....	....	..	12	0.31	NW	brisk	strati and scud.....	Morning fine—showery—close and oppressive.
	3		29.69	.....	0.449	71	61	10	5.845	5.950	8.027	74	..	....	....	..	..	1.04	.....	.....	do. cirro-cumuli and cumuli	Showers.
	10		29.75	.....	0.584	61	60	1	5.750	5.761	5.950	..	59	....	0.07	..	11	0.09	.....	.....	dissolving	Clouds all cleared off and fine moon-light.
4	9	⊙	29.87	+ 0.28	0.507	66	59	7	5.506	5.570	6.922	..	..	....	....	..	11	0.66	SW	little	high cirri	Great deposition of moisture upon windows—morning very fine.
	4		29.85	.....	0.576	70	62	7	6.232	6.310	7.776	70	..	....	....	..	..	0.73	.....	brisk	do. and cumulo-strati	More overcast.

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Sept. 4	10		29.83	.....	0.597	64	64	0	6.506	6.506	6.506	..	60	....	0.05	..	10	....	.....	.....	.....	Steady rain and close.
5	10		29.74	— 0.15	0.560	63	60	1	6.115	6.126	6.310	..	..	....	....	..	13	0 09	.....	brisk	stratus and nimbus.....	Hard rain.
	5		29.75	.....	0.578	65	63	2	6.676	6.310	6.614	66	.	....	....	..	..	0.19	.....	.....	.....	Cleared at twelve—fine sun shine—showers.
	10		29.76	.....	0.499	56	54	2	4.752	4.770	5.068	..	48	....	0.29	..	9	0.15	.....	.....	dissolving	Fine moon-light.
6	9		29.87	.....	0.328	62	46	16	3.587	3.689	6.126	..	..	....	....	..	9	1.15	NWW	brisk	cumulo-strati	Very fine morning.
	3		29.93	.....	0.328	66	46	20	3.562	3.689	6.912	66	..	....	....	..	..	1.59	.....	.....	ditto and cumuli	Exhilarating day—beautiful evening.
	10		29.96	.....	0.351	55	48	7	3.890	3.940	4.910	..	..	....	....	..	10	0.48	.....	.....	.....	Night fine—moon very sharp—overcast at one.
7	9		29.97	.....	0.578	65	63	2	6.267	6.310	6.614	..	..	....	....	..	10	0.19	SWW	ditto	stratus and hazy	Cloudy, hazy morning—oppressive.
	4		29.97	.....	0.597	71	64	7	6.426	6.506	8.067	72	..	....	....	..	1	0.76	.....	.....	.....	Very lowering and oppressive.
	10		30.00	.....	0.597	66	64	2	6.483	6.506	6.912	..	61	....	....	..	14	0.20	.....	ditto	cirro-cumuli.....	Moon and stars rarely visible.
8	9		30.03	.....	0.560	70	62	8	6.075	6.126	7.776	..	..	....	....	..	13	0.64	NWW	little	cumuli and cumulo-strati....	Fine morning—some heavy clouds moving in different directions.
	4		30.04	.....	0.584	70	60	10	5.860	5.761	7.776	74	..	....	....	..	..	0.76	NW	.....	cirri and ditto	Clearing in the S.E.
	11		30.04	.....	0.597	68	59	3	5.545	5.570	6.126	..	58	....	....	..	10	0.21	NWN	calm	few in the horizon	Beautiful night—moon quite sharp—clouded at one.
9	9		30.05	+ 0.31	0.597	68	59	9	5.436	5.570	7.316	..	..	....	....	..	12	0.67	SE	little	cumuli and cum.-strati ; hazy	Fine morning—some heavy clouds.
	4		30.02	— 0.03	0.490	71	58	13	5.074	5.402	8 027	72	..	....	....	..	..	1.02	W	calm	Ditto ditto and cirri	Clouds increasing.
	10		30.03	+ 0.01	0.542	63	61	2	5.928	5.950	6.310	..	59	....	....	..	11	0.18	SE	brisk	fog.....	Overcast and misty—thick fog during the night.
10	9		30.01	.....	0.507	67	59	8	5.498	5.570	7.013	..	..	....	....	..	12	0.59	SEE	little	ditto.....	Morning misty but fine.
	4		29.96	— 0.07	0.443	70	55	15	4.685	4.910	7.776	70	..	....	....	..	..	1.11	.....	calm	cirro-cumuli.....	Very fine but hazy.
	10		29.97	.....	0.458	59	56	3	5.034	5.068	5.570	..	52	....	....	..	8	0.20	NE	ditto	cirri and hazy	Beautiful night—moon sharp and stars bright.
11	9	☾	30.00	.....	0.474	63	57	6	5.174	5.235	6.310	..	..	....	....	..	10	0.41	.....	little	stratus.....	Cloudy morning.
	4		30.02	.....	0.474	64	57	7	5.165	5.235	6.506	64	..	....	....	..	..	0.64	.....	brisk	ditto and send	Overcast all day—and no rain.
	10		30.07	.....	0.458	61	56	5	5.018	5.068	5.950	..	56	....	....	..	11	0.44	.....	declining	overcast	Much overcast—falling mist or small rain.
12	9		30.14	+ 0.18	0.401	64	52	12	4.369	4.468	6.506	..	..	....	....	..	9	1.25	NEN	high	cirri and small cumuli.....	Morning very fine—exhilarating.
	4		30.13	— 0.01	0.339	67	17	20	3.674	3.815	7.013	67	..	....	....	..	..	1.62	.....	brisk	ditto ditto	Beautiful day.
	10		30.16	.....	0.339	52	47	5	3.777	3.815	4.468	..	45	....	....	..	6	0.24	.....	calm	none.....	Night perfectly clear.
13	9		30.03	+ 0.10	0.363	63	49	14	3.981	4.068	6.310	..	..	....	....	..	8	0.86	SEE	little	cirri	Beautiful morning.
	4		30.00	.....	0.375	66	50	16	4.073	4.195	6.912	66	..	....	....	..	..	1.04	.....	ditto	ditto.....	Perfectly fine.
	10		30.00	.....	0.401	56	52	4	4.435	4.468	5.068	..	49	....	....	..	8	0.23	.....	calm	none.....	Night—stars bright.
14	9		30.19	.....	0.474	62	57	5	5.183	5.235	6.126	..	..	....	....	..	10	0.34	.....	ditto	mist	Foggy morning—sun broke through at nine.
	3		30.13	.....	0.443	72	55	17	4.756	4.910	8.270	72	..	....	....	..	..	1.68	.....	brisk	cirri	Cloudless day—evening rather hazy.
	10		30.08	.....	0.490	61	58	3	5.368	5.402	5.950	..	53	....	....	..	9	0.21	.....	little	none.....	Beautiful clear night—much moisture deposited upon dry wood, slate, &c.

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METEOROLOGICAL JOURNAL—*continued.*

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Contiguous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force in grs. of evaporation, from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
Sep. 15	9		29.92	.....	0.507	66	59	7	5.514	5.570	6.912	..	..	..	.....	..	11	0.61	E	calm	cirri and cirro-cumuli	Misty morning, but fine.
	4		29.82	.....	0.616	68	65	3	6.579	6.614	7.316	68	..	....	.....	..	..	0.84	SWW	ditto	stratus and nimbus	Clouded over, began to rain about two o'clock—gentle mist—sun shone at five.
	10		29.73	.....	0.597	65	64	1	6.494	6.506	6.614	..	53	....	0.06	..	12	0.07	.....	.....	overcast	Very dark night—hard rain—some lightning very close
16	9		29.68	— 0.27	0.375	55	50	5	4.157	4.195	4.810	..	..	....	.....	..	10	0.42	N	high	stratus and scud	Morning lowering—showery.
	4		29.70	.....	0.278	56	41	15	3.019	3.106	5.068	56	..	....	.....	..	..	0.95	.....	brisk	cirro-cumuli and cirri	Clearing at twelve—sun shone at half past two—fresh and pleasant.
	10		29.79	.....	0.254	48	39	9	2.849	2.900	3.940	..	43	....	0.19	..	7	0.78	.....	declining	few and light	Very fine—stars bright.
17	9		29.87	.....	0.339	58	47	11	3.736	3.815	5.402	..	..	....	.....	..	9	0.95	NE	high	cirri and scud	Very fine fresh morning.
	4		30.03	.....	0.316	59	45	14	3.471	3.570	5.570	61	..	....	.....	..	..	1.20	N	little	cirri and hazy	Fine all day.
	10		30.09	.....	0.339	58	47	5	3.777	3.815	4.468	..	50	....	.....	..	7	0.24	.....	calm	overcast	Stars dim—dark in the south.
18	9		30.14	+ 0.48	0.401	60	52	8	4.400	4.468	5.761	..	..	....	.....	..	10	0.50	NW	ditto	stratus and hazy	Very misty and overcast.
	4		30 10	— 0.04	0.443	63	55	8	4.836	4 910	6.310	65	..	....	.....	..	..	0.54	.....	little	cirri and cirro-cumuli	Clouds began to break about twelve—very fine afternoon.
	10		30.13	.....	0.388	53	51	2	4.314	4.390	4.616	..	46	....	.....	..	10	0.11	.....	calm	none	Beautiful night.
19	9	●	30.15	+ 0.05	0.468	60	40	20	2.697	2.699	5.761	..	..	....	.....	..	7	1.95	N	brisk	cirri and cumulo-strati.....	Fine morning—sun obscured at intervals.
	4		30.14	— 0,01	0.237	57	37	20	2.617	2.717	5.235	61	..	....	.....	..	..	1.21	.....	ditto	ditto ditto	Afternoon fine, fresh, and exhilarating.
	10		30.18	.....	0.294	49	43	6	3.236	3.306	4.068	..	41	....	.....	..	5	0.27	.....	calm	none.....	Stars very bright.
20	9		30.27	.....	0.306	56	46	10	3.629	3.699	5 068	..	..	....	.....	..	9	0.67	NE	brisk	light cumulo-strati.....	Fine and fresh.
	7		30.31	.....	0 316	52	45	7	3.521	3.570	4.468	60	..	....	.....	..	..	0.44	.....	ditto	none.....	Beautiful day.
	10		30.35	.....	0.316	50	45	5	3.504	3.570	4.195	.	40	....	.....	..	8	0.84	.....	calm	none.....	Stars bright and strong dew.
21	9		30.41	.....	0.339	55	47	8	3.736	3.815	4.910	..	..	....	.....	..	9	0.53	.....	brisk	cirri	Very fine.

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Sep. 21	10		30.41	+ 0.27	0.316	50	45	5	3.534	3.570	4.198	61	42	....	....	..	8	0.30	.....	.....	none.....	Stars very bright.
22	9		30.39	.....	0.331	56	48	8	3.883	3.940	5.068	..	..	....	....	..	8	0.55	E	little	cirro-cumuli.....	Beautiful morning.
	5		30.30	.....	0.398	59	46	13	3.603	3.699	5.570	62	..	....	....	..	..	0.93	.....	brisk	cumulo-strati	Clouded over about two o'clock.
	10		30.29	.....	0.363	54	49	5	4.031	4.068	4.770	..	50	....	....	..	9	0.26	.....	calm	few	Stars dim—clearer.
23	9		30.20	.....	0.339	56	47	9	3.750	3.815	5.068	..	..	....	....	..	9	0.47	.....	ditto	stratus and cumulo-stratus..	Morning overcast.
	4		30.07	.....	0.328	59	46	13	3.606	3.690	5.570	61	..	....	....	..	..	0.72	.....	little	stratus and haze	Overcast and hazy all day.
	10		30.01	.....	0.375	56	50	6	4.149	4.195	5.068	..	51	....	....	..	8	0.33	.....	calm	overcast	Overcast and dull.
24	9		29.86	.....	0.401	58	52	6	4.420	4.468	5.402	..	..	....	....	..	11	0.36	ES	little	cumulo-strati	Clouds heavy—sun sometimes breaking through.
	4		29.74	.....	0.339	61	47	14	3.713	3.815	5.980	64	..	....	....	..	..	1.04	.....	brisk	Cirri	Very fine.
	10		29.59	.....	0.375	53	50	3	4.172	4.195	4.616	..	46	....	...	..	9	0.16	.....	calm	none.....	Beautiful night.
25	9		29.57	.....	0.174	58	57	1	5.225	5.235	5.402	..	..	....	....	..	13	0.06	SE	ditto	strati and cumulo-strati	Some rain and very misty.
	5		29.51	.....	0.490	60	58	2	5.377	5.402	5.761	63	..	....	....	..	..	0.14	SW	little	cirri and scud	Hard rain till three o'clock—clouds breaking.
	10		29.50	— 0.91	0.443	55	55	..	4.910	4.910	4.910	..	50	....	0.32	..	12	....	.....	ditto	overcast	Hard rain.
26	10		29.52	.....	0.388	59	51	8	4.260	4.330	5.570	..	..	....	....	..	11	0.48	W	ditto	cirri and cumuli and scud ..	Fine morning, with some haze and showers.
	3		29.57	.....	0.228	58	46	12	3.616	3.699	5.402	61	..	....	....	..	..	0.84	.....	brisk	cumulo-strati	Very fine.
	10	☽	29.63	+ 0.13	0.351	53	48	5	3.900	3.940	4.616	..	48	....	0.13	..	15	0.26	.....	calm	light.....	Stars dull—rain in the night.
27	9		29.57	— 0.06	0.443	61	55	6	4.853	4.910	5.950	..	..	....	....	..	15	0.40	SW W	little	cirri & cumulo-strati & haze	Fine morning.
	4		29.61	.....	0.524	63	60	3	5.730	5.761	6.310	66	..	....	....	..	..	0.27	.....	brisk	cirri, stratus and scud	Hard showers.
	10		29.62	+ 0.05	0.524	60	60	..	5.761	5.761	5.761	..	57	....	0.41	..	16	....	.....	stormy	overcast	Night very stormy, and hard rain.
28	9		29.58	— 0.04	0.507	65	59	6	5.516	5.570	6.614	..	..	....	...	..	17	0.68	.....	ditto	cirri and scud	Morning very stormy, and hard showers.
	4		29.61	+ 0.03	0.490	60	58	2	5.377	5.402	5.761	66	..	....	....	..	..	0.82	.....	high	cirri and strati	Rained, with little intermission, till one o'clock—sun shone hot and bright at three o'clock.
	11		29.59	.....	0.524	60	60	0	5.761	5.761	5.761	..	55	....	0.40	..	16	....	.....	ditto	lowering.....	Very cloudy and showery—close and oppressive.
29	9		29.55	— 0.06	0.524	60	60	0	5.761	5.761	5.761	..	..	....	....	..	17	....	.....	stormy	stratus and scud	Hard steady rain.
	4		29.62	.....	0.489	60	54	6	4.714	4.770	5.761	64	..	....	....	..	..	0.39	W	little	cirri and cirro-cumuli	Cleared at three—fine evening.
	10		29.67	.....	0.474	58	57	1	5.225	5.235	5.402	..	56	....	....	..	17	0.06	.....	ditto	stratus and cumulo-stratus..	Night stormy and showery.
30	9		29.76	.....	0.524	63	60	3	5.730	5.761	6.310	..	..	....	0.16	..	17	0 27	SW	brisk	stratus.....	Morning showery.
	4		29.79	+ 0.24	0.560	68	62	4	6.068	6.126	6.912	66	..	....	....	..	..	0.44	.....	ditto	ditto and cumulo-stratus	Close, oppressive, and light showers.
	10		29.79	.....	0.524	63	60	3	5.730	5.761	6.310	..	58	....	....	..	16	0.87	.....	ditto	ditto ditto	Moon very hazy—clouds moving with much velocity.
Oct. 1	9		29.78	.....	0.587	67	59	8	5.496	5.570	7.013	..	..	....	....	..	15	0.76	.....	ditto	cirri and cirro-cumuli	Morning fine, hot and oppressive.
	5		29.73	.....	0.578	68	63	5	6.254	6.310	7.316	68	..	....	....	..	..	0.50	.....	.....	ditto ditto and stratus..	Very oppressive, hazy and cloudy.
	10		29.73	.....	0.524	62	60	2	5.740	5 761	6.126	..	58	....	....	..	15	0.14	.....	little	cirri	Night cloudless, moon perfectly bright—very oppressive.

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METEOROLOGICAL JOURNAL.—*continued.*

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Contingencies and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force in grs. of evaporation from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	15	17		18	19	20	21	22
Oct. 2	9		29.87	—0.12	0.507	68	59	9	5.487	5.570	7.316	..	..	....	....	..	17	0.67	SWS	little	stratus and cumulo-stratus..	Slight showers at eight o'clock.
	4		29.71	.....	0.474	65	57	8	5.156	5.935	6.614	68	..	....	....	..	..	0.73	SW	brisk	cirri and cumuli	Very fine, not nearly so oppressive.
	10		29.72	+ 0.05	0.490	60	58	2	5.377	5.409	5.761	..	56	....	....	..	15	0.14	.....	little	cirro-cumuli.....	Night fine, moon veiled by light clouds.
3	10		29.69	.....	0.507	65	59	6	5.516	5.570	6.614	..	..	....	....	..	15	0.55	.....	brisk	stratus and scud	Slates very wet—clouds low and heavy.
	4	○	29.64	.....	0.458	63	56	7	5.000	5.468	6.310	68	..	....	....	..	..	0.48	.....	little	cirri and cumuli.....	Flying showers, fine in the intervals.
	10		29.60	.....	0.458	57	56	1	5.058	5.068	5.235	..	51	....	0.06	..	15	0.07	.....	ditto	cumulo-strati, light	Night—moon very clear—few clouds but some showers.
4	9		29.53	—0.19	0.458	62	56	6	5.009	5.068	6.126	..	..	....	....	..	14	0.41	NWN	ditto	ditto and stratus	Overcast and dull, cleared about eleven and sun shone.
	4		29.56	.....	0.378	56	51	5	4.291	4.320	5 068	62	..	....	....	..	..	0.36	NWN	brisk	ditto and ditto	Very fine till two o'clock, very light showers, double rainbow at half past five.
	10		29.62	.....	0.283	46	42	4	3.190	3.214	3.699	..	38	....	....	..	10	0.18	.....	little	cumulo-stratus.....	Very fine moonlight, with light scudding clouds.
5	9		29.88	.....	0.373	47	41	6	3.072	3.108	3.815	..	..	....	0.04	..	8	0.35	.....	brisk	none.....	Morning cloudless, air perfectly transparent.
	4		29.99	.....	0.307	48	33	15	2.333	2.383	3 940	50	..	....	....	..	..	0.73	.....	ditto	cumuli and cumulo-strati ..	Very fine, fresh, and exhilarating.
	11		30.06	.....	0.251	46	39	7	2.862	2.900	3.699	..	30	....	....	..	8	0.09	.....	little	cirro-cumuli.....	Fine moonlight till half past ten, an iridescent halo, and then overcast.
6	9		30.09	+ 0.44	0.398	53	49	7	3.649	3.689	4.616	..	..	....	....	..	9	0.35	W	ditto	stratus and haze	Morning overcast.
	5		29.95	.....	0.401	54	52	2	4.451	1.468	4.770	55	..	....	....	..	..	0.14	.....	brisk	stratus.....	Overcast all day—rained at four.
	10		29.94	.....	0.431	53	50	1	4.460	4 466	4.616	..	52	....	....	..	11	0.10	.....	equally	ditto	Overcast, showery and equally.
7	9		29.89	.....	0.443	58	56	1	4.901	4.910	5 068	..	..	....	....	..	15	0.07	.....	brisk	ditto	Lowering and dull.
	4		29.88	—0.21	0.443	60	55	5	4.861	4.910	5.761	60	..	....	....	..	..	0.49	.....	brisk	ditto	Ditto and light showers.
	10		29.91	.....	0.458	57	56	1	5.058	5.068	5.235	..	50	....	....	..	15	0.08	.....	ditto	ditto	Heavy and lowering.
8	9		30.00	.....	0.507	63	59	4	5.534	5.570	6.310	..	..	....	....	..	14	0.98	.....	calm	ditto and mist	Morning heavy and oppressive.

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Oct. 8	4		30.00	.....	0.542	64	61	3	5.918	5.950	6.506	65	..	....	....	..	..	0.22	SWW	little	stratus and mist	Hazy and hot all day.
	10		30.00	+ 0.12	0.507	59	59	..	5.570	5.570	5.570	..	53	....	....	..	17	....	.....	calm	overcast	Small rain.
9	9		29.92	.....	0.458	60	56	4	5.027	5.068	5.761	..	..	....	....	..	16	0.27	S	little	stratus.....	Very lowering, hot, and dull.
	4		29.80	.....	0.474	61	57	9	5.193	5.235	5.950	61	..	....	....	..	..	0.36	SES	brisk	ditto and cumulo-stratus ..	Sun broke through at half past ten—some rain at two.
	10		29.76	— 0.24	0.474	59	57	2	5.207	5.235	5.570	..	55	....	....	..	15	0.28	.....	ditto	ditto ditto	Very cloudy.
10	9		29.78	.....	0.578	65	63	2	6.287	6.310	6.614	..	..	....	....	..	15	0.15	SW	little	ditto ditto	Morning fine but hazy.
	4		29.78	.....	0.635	70	66	4	6.863	6.912	7.776	70	..	....	....	..	..	0.43	.....	brisk	cirri and cirro-cumuli	Fine hot sun-shine, few clouds but hazy—hot and oppressive.
	10		29.79	.....	0.542	62	61	1	5.939	5.950	6.126	..	57	....	....	..	15	0.07	.....	little	ditto ditto and stratus ..	Clear in the west, dark in the east.
11	9	☾	29.82	.....	0.524	66	60	6	5.700	5.761	6.912	..	..	....	....	..	16	0.57	SE	brisk	cirro-cumuli and hazy	Heavy moisture on slates, flag-stones, and dust—fine and misty.
	4		29.84	.....	0.542	67	61	6	5.887	5.950	7.013	68	..	....	....	..	..	0.45	SW	little	ditto and cirri	Beautiful day.
	10		29.88	.....	0.474	58	57	1	5.225	5.235	5.402	..	52	....	....	..	14	0.06	.....	calm	none	Night cloudless, but stars dull—dense fog at 9 o'clock.
12	9		29.96	.....	0.524	61	60	1	5.750	5.761	5.950	..	..	....	....	..	15	0.07	SE	ditto	mist	Great moisture on slates, &c.—morning cloudless but misty.
	4		29.97	.....	0.578	70	63	7	6.232	6.310	7.776	70	..	....	....	..	..	0.57	.....	ditto	ditto and cumuli.....	Cloudless till four o'clock.
	10		29.97	+ 0.21	0.524	60	60	..	5.761	5.761	5.761	..	57	....	....	..	15	....	.....	brisk	very dark	Copious small rain, very dark.
13	9		29.93	— 0.04	0.542	65	61	4	5.908	5.950	6.614	..	..	....	....	..	16	0.29	W	calm	stratus and mist	Heavy fog in the night—great deposition of moisture—very dull.
	4		29.94	.....	0.507	63	59	4	5.535	5.570	6.310	67	..	....	....	..	..	0.28	.....	ditto	cumuli and cumulo-strati ..	Sun broke through at half past two.
	10		29.99	.....	0.388	53	51	2	4.314	4.330	4.616	..	47	....	....	..	12	0.11	.....	ditto	cirri	Beautiful clear night.
14	9		30.04	.....	0.388	56	51	5	4.291	4.330	5.068	..	..	....	....	..	13	0.28	NW	ditto	stratus and mist	Moisture upon slates—morning dull and misty.
	4		30.08	.....	0.458	60	56	4	5.027	5.068	5.761	60	..	....	....	..	..	0.27	.....	ditto	ditto ditto	Dull and heavy.
	11		30.11	.....	0.443	55	55	..	4.910	4.910	4.910	..	46	....	0.05	..	10	....	.....	little	.....	Showers of small rain, stars at intervals.
15	9		30.23	.....	0.388	55	51	4	4.298	4.330	4.910	..	..	....	....	..	12	0.29	NE	brisk	few cumuli	Moisture upon slates—very fine.
	4		30.26	.....	0.316	56	45	11	3.496	3.570	5.068	59	..	....	....	..	..	0.57	.....	little	cirri	Clouds dissolved about three.
	10		30.29	+ 0.36	0.363	49	49	..	4.068	4.068	4.068	..	44	....	....	..	11	....	.....	calm	heavy fog	Great damp and very heavy fog.
16	9		30.19	.....	0.375	54	50	4	4.164	4.195	4.770	..	..	....	....	..	11	0.28	NW	brisk	stratus.....	Moisture on slates, morning dull—clearing in the north.
	4		30.17	.....	0.254	51	39	12	2.834	2.900	4 330	55	..	....	....	..	..	0.53	N	little	cirro-cumuli.....	Fresh day, but generally dull.
	10		30.07	— 0.22	0.283	46	42	4	3.184	3.214	3.699	..	38	35	....	..	10	0.23	.....	brisk	thin stratus	Beautiful night.
17	9		30.09	.....	0.254	45	39	6	2.868	2.900	3.570	..	..	....	....	..	9	0.39	NEN	high	light cumulo-strati	Morning very fine, but fresh.
	4		30 12	.....	0.254	46	39	7	2.862	2 900	3.699	50	..	....	....	..	..	0.46	.....	ditto	cumuli	Beautiful day but more clouds, showers with rainbow at three o'clock.
	10		30.15	.....	0.254	42	39	3	2.583	2.900	3.214	..	37	33	....	..	9	0.14	.....	brisk	none.....	Beautiful night, stars bright.
18	9		30.18	.....	0.273	46	41	5	3.077	3.106	3.699	..	..	....	....	..	11	0.28	NE	ditto	none.....	Cloudless morning, moisture on slates.
	4		30.18	+ 0.11	0.254	49	39	10	2.845	2 900	4.068	53	..	....	....	..	..	0.55	N	ditto	few in the horizon	Beautiful day.

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METEOROLOGICAL JOURNAL—*continued.*

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
Oct. 18	10		30.17	.....	0.254	39	39	..	2.900	2.900	2.900	..	32	....	....	..	9	....	.....	calm	fog	Night cloudless, stars dull, foggy smell.
19	9	●	30.09	.....	0.273	44	41	3	3.088	3.106	3.452	..	..	....	....	..	10	0.13	NWW	ditto	stratus and fog.....	Morning very foggy.
	4		29.99	.....	0.316	49	45	4	3.540	3.570	4.068	53	..	....	....	..	..	0.19	WS	ditto	haze	At one o'clock clouds broke into cirro-cumuli, and then dissolved.
	10		29.90	.....	0.363	50	49	1	4.060	4.068	4.195	..	46	....	....	..	12	0.05	.....	ditto	fog	Foggy.
20	9		29.66	.....	0.458	56	56	..	5.068	5.068	5.068	..	..	....	....	..	16	....	SW	brisk	stratus and cumulo-stratus..	Overcast and showery.
	4		29.56	.....	0.401	52	52	..	4.468	4.468	4.468	57	..	....	....	..	..	....	.....	little	stratus.....	Steady hard rain.
	10		29.56	.....	0.388	51	51	..	4.330	4.330	4.330	..	40	....	0.35	..	19	....	.....	calm	ditto.....	Ditto ditto close.
21	9		29.50	.....	0.273	42	41	1	3.100	3.106	3.214	..	..	....	....	..	14	0.05	NW	brisk	ditto and cumulo-stratus....	Dull and overcast.
	4		29.50	.....	0.237	39	37	2	2.717	2.717	2.717	43	..	....	....	..	..	0.07	.....	little	cumuli.....	Rain, accompanied with snow in large flakes.
	10		29.38	—0.80	0.237	37	37	..	2.717	2.717	2.717	..	30	28	0.14	..	15	....	.....	stormy	very dark	Hard rain or sleet.
22	9		29.40	.....	0.207	35	33	2	2.384	2.393	2.515	..	..	....	....	..	11	0.07	.....	calm	cirro-cumuli and haze	Fall of snow in the night half foot deep—morning fine.
	4		29.41	.....	0.283	42	42	..	3.214	3.214	3.214	42	..	....	....	..	..	....	.....	little	cumulo-stratus.....	Clouded over—rainy.
	10		29.43	+ 0.05	0.273	41	41	..	3.106	3.106	3.106	..	32	25	....	..	14	....	.....	ditto	.....	Rained greater part of the evening—night cleared up.
23	9		29.33	.....	0.254	40	39	1	2.894	2.900	2.999	..	..	....	....	..	13	0.03	NWW	calm	haze	Morning fine and hazy—very damp.
	4		29.30	.....	0.328	47	46	1	3.692	3.699	3.815	47	..	....	....	..	..	0.05	.....	little	cirro-cumuli & cumulo-strati	Hard showers.
	10		29.30	—0.13	0.263	41	40	1	2.993	2.999	3.106	..	32	27	....	..	14	0.05	.....	brisk	none.....	Night very fine.
24	9		29.30	.....	0.273	42	41	1	3.100	3.106	3.214	..	..	....	....	..	13	0.05	N	ditto	cirro-stratus	Morning fine and clear—great damp upon every thing.
	4		29.39	.....	0.254	44	39	5	2.873	2.900	3.452	44	..	....	....	..	..	0.32	.....	high	cumulo-strati	Cloudy, dull and cold.
	11		29.37	.....	0.207	39	33	6	2.364	2.393	2.900	..	32	30	....	..	12	0.30	.....	ditto	overcast	Dark and windy.

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Oct. 25	9		29.39	.....	0.214	41	31	7	2.404	2.438	3.106	..	..	....	.....	..	11	0.23	NW	little	cirro-cumuli and strati.....	Morning fine—clouds gradually breaking.
	4		29.43	.....	0.221	42	35	7	2.509	2.545	3.214	42	..	....	.....	..	..	0.23	.....	ditto	ditto and fog	Day fine but hazy.
	10		29.48	.....	0.221	36	35	1	2.535	2.545	2.639	..	30	92	.....	..	11	0.02	N	ditto	light stratus and fog	Foggy—some rain in the night.
26	9	)	29.57	.....	0.283	44	42	2	3.202	3.214	3.452	..	..	....	.....	..	12	0.09	.....	ditto	light stratus	Slight showers—misty.
	4		29.63	.....	0.281	42	35	7	2.569	2.545	3.214	44	..	....	.....	..	..	0.23	.....	calm	cirri and cumulo-strati.....	Sun broke through at half past eleven, very fine
	10		29.71	.....	0.200	35	32	3	2.304	2.317	2.545	..	97	17	.....	..	10	0.10	.....	ditto	none.....	Night perfectly fine.
27	9		29.75	.....	0.207	37	33	4	2.372	2.493	2.717	..	..	....	.....	..	11	0.12	NEN	ditto	cirro-cumuli and haze	Morning very fine—hoar frost.
	4		29.75	.....	0.294	43	43	..	3.326	3.326	3.326	43	..	....	.....	.	..	....	NE	ditto	stratus.....	Very hazy—small rain.
	11		29.76	+ 0.46	0.237	38	37	1	2.711	2.717	2.803	..	30	93	0.06	..	13	0.03	.....	ditto	ditto and cumulo-stratus	Night dull.
28	9		29.75	.....	0.245	39	38	1	2.796	2.803	2.900	..	..	....	.....	..	12	0.04	.....	little	cirro-cumuli	Morning fine—white frost—great deposition of moisture.
	4		29.75	.....	0.273	43	41	2	3.094	3.106	3.326	43	..	....	.....	..	..	0.09	.....	ditto	cumuli and cumulo-strati ..	Foggy.
	10		29.71	.....	0.207	34	33	1	2.388	2.393	2.438	..	31	95	.....	..	12	0.04	.....	brisk	stratus.....	Overcast—cleared up and stars bright.
29	9		29.54	.....	0.229	36	36	..	2.629	2.629	2.629	..	..	....	.....	..	12	....	NEE	ditto	ditto and cumulo-stratus....	Dull, cold and rainy.
	4		29.51	.....	0.283	42	42	..	3.214	3.214	3.214	43	..	....	.....	..	..	....	.....	high	ditto ditto	Rained the greatest part of the day, with fog.
	10		29.50	—0.26	0.254	41	39	2	2.889	2.900	3.106	..	39	36	0.30	..	13	0.11	.....	stormy	ditto ditto	Night stormy, with much rain.
30	9		29.52	.....	0.283	42	42	..	3.214	3.214	3.214	..	..	....	.....	..	14	....	E	ditto	ditto ditto	Windy and heavy rain.
	4		29.51	.....	0.294	43	43	..	3.326	3.326	3.326	44	..	....	.....	..	..	....	.....	ditto	ditto ditto	Rain all day.
	11		29.61	.....	0.328	46	46	..	3.699	3.699	3.699	..	43	44	0.68	..	16	....	.....	little	ditto ditto	Hard rain and stormy.
31	10		29.76	.....	0.351	48	48	..	3.940	3.940	3.940	..	..	....	.....	..	20	....	.....	ditto	ditto ditto	Overcast and rainy.
	4		29.77	.....	0.339	47	47	..	3.815	3.815	3.815	47	..	....	.....	..	..	....	.....	ditto	ditto ditto	Rain all day.
	10		29.82	+ 0.32	0.339	47	47	..	3.815	3.815	3.815	..	45	43	0.50	..	16	....	.....	ditto	ditto ditto	Rain all night.
Nov. 1	9		29.79	.....	0.316	45	45	..	3.570	3.570	3.570	..	..	....	.....	..	17	....	.....	ditto	ditto ditto	Steady rain and little wind.
	4		29.70	.....	0.328	47	46	1	3.692	3.699	3.815	47	..	....	.....	..	..	0.05	.....	ditto	ditto ditto	Rain till half past one, clouds then broke.
	11		29.66	.....	0.283	42	42	..	3.214	3.214	3.214	..	38	32	0.02	..	15	....	.....	calm	ditto ditto	Moon visible through passing clouds.
2	9	O	29.65	.....	0.305	44	44	..	3.452	3.452	3.452	..	..	.. .	.....	..	13	....	NW	little	cirri and cumulo-strati.....	Morning fine, very damp.
	4		29.65	.....	0.214	43	34	9	2.395	2.438	3.326	44	..	....	.....	..	..	0.32	.....	ditto	cirri and cirro-cumuli	Fine but misty—sun red.
	10		29.65	—0.17	0.245	39	38	1	2.797	2.803	2.900	..	33	26	.....	..	12	0.04	.....	calm	ditto and haze	Fine—hazy—hoar frost.
3	9		29.82	.....	0.229	40	36	4	2.629	2.629	2.999	..	..	....	.....	..	11	0.17	.....	brisk	none	Beautiful morning.
	4		29.88	.....	0.221	41	35	6	2.514	2.545	3.106	41	..	....	.....	..	..	0.19	.....	little	cumulo-strati	Day nearly cloudless—cold—red sun-set.
	11		29.92	+ 0.27	0.221	36	35	1	2.537	2.545	2.629	..	33	26	.....	..	12	0.02	.....	calm	ditto very light.....	Night fine.
4	9		29.88	.....	0.273	46	41	5	3.077	3.106	3.699	..	..	....	.....	..	12	0.22	NWW	little	light stratus	Morning fine but hazy.

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METEOROLOGICAL JOURNAL—*continued.*

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 lin. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
Nov. 4	4		29.85	.....	0.398	51	46	5	3.622	3.699	4.330	51	..	....	....	..	..	0.24	W	little	ditto and mist	Overcast but clouds high.
	10		29.80	.....	0.395	46	44	2	3.622	3.458	3.699	..	34	40	....	..	14	0.09	.....	ditto	light cumulo-stratus	Fine—light clouds and halo.
5	9		29.68	.....	0.395	51	44	7	3.405	3.458	4.330	..	..	....	....	..	14	0.42	SW	brisk	stratus and mist	Morning overcast with light clouds and misty.
	4		29.57	.....	0.386	52	51	1	4.721	4.340	4.468	52	..	....	....	..	..	0.05	.....	little	ditto and ditto	Clouds lower—hard rain for several hours.
	10		29.50	.....	0.363	49	49	..	4.068	4.068	4.068	..	43	40	0.17	..	16	....	.....	ditto	stratus.....	Fine—moon clear at intervals.
6	9		29.40	.....	0.398	47	46	1	3.892	3.699	3.815	..	..	....	....	..	15	0.07	W	brisk	ditto cirri and haze.....	Fine but hazy—great damp.
	4		29.40	.....	0.316	48	45	3	3.547	3.570	3.940	49	..	....	....	..	..	0.14	SW	little	cirri and cumulo strat.....	Day fine—afterwards hazy.
	10		29.33	—0.59	0.273	45	41	4	3.063	3.106	3.570	..	38	34	....	..	12	0.08	.....	high	none.....	Night cloudless—moon and stars perfectly bright.
7	10		29.39	.....	0.316	46	45	1	3.563	3.570	3.699	..	..	....	....	..	12	0.05	NWW	little	light stratus in the horizon..	Morning fine—hazy.
	4		29.45	.....	0.294	45	43	2	3.313	3.326	3.570	46	..	....	....	..	..	0.08	.....	ditto	stratus and cirro-cumulus ..	Several showers—very misty.
	10		29.47	.....	0.237	38	37	1	2.712	2.717	2.803	..	34	37	....	..	11	0.03	.....	calm	none	Night fine.
8	10		29.52	.....	0.263	40	40	..	2.999	2.999	2.999	..	..	....	....	..	11	....	NEN	brisk	stratus and cumulo-stratus ..	Great damp—morning fine but misty.
	4		29.55	.....	0.289	42	36	6	2.809	2.629	2.914	43	..	....	....	..	..	0.07	.....	ditto	ditto ditto	Day overcast—sun rarely breaking through.
	11		29.78	.....	0.193	35	31	4	2.204	2.240	2.545	..	28	....	....	..	10	0.13	.....	calm	none	Night very fine.
9	9	☾	29.20	+ 0.47	0.193	34	31	3	2.206	2.240	2.438	..	..	...	....	..	11	0.09	NW	ditto	none.....	Beautiful morning—hard frost.
	4		29.74	.....	0.289	40	36	4	2.806	2.629	2.999	41	..	....	....	..	..	0.13	WS	little	cumulo-stratus and mist	Day very fine—overcast about four.
	10		29.80	.....	0.289	42	36	6	2.999	2.629	2.914	..	36	35	....	..	11	0.33	.....	high	.....	Overcast and very dark.
10	9		29.28	.....	0.398	47	46	1	3.804	3.699	3.815	..	..	....	....	..	19	0.05	NW	calm	stratus and cumulo-stratus..	Hard rain in the morning—sun broke through at intervals.
	4		29.30	—0.50	0.398	47	46	1	3.804	3.699	3.815	48	..	....	....	..	..	0.05	.....	ditto	ditto ditto and mist	Rain at three—lowering.

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Nov. 10	10		29·37	.....	0.305	44	44	..	3·452	3·452	3·452	..	43	40	0.15	..	13	....	NE	little	overcast	hard rain—very dark.
11	10		29·58	.....	0.316	46	45	1	3·564	3·570	3·699	..	..	....	....	..	15	0.07	.....	high	stratus and cumulo-stratus ..	Hard rain.
	4		29·70	.....	0.294	43	43	..	3·326	3·326	3·326	46	..	....	....	..	..	....	.....	ditto	ditto	Very dull—much rain and wind all day.
	10		29·84	.....	0.273	43	41	2	3·093	3·106	3·326	..	37	32	0.24	..	13	0.14	.....	ditto	overcast	Morning fine and fresh.
12	9		29·89	+ 0.59	0.254	42	39	3	2·884	2·900	3·214	..	..	....	....	..	12	0.18	.....	ditto	cirro-cumuli and stratus	Light flying showers.
	4		29·88	.....	0.254	44	39	5	2·872	2·900	3·452	45	..	....	....	..	..	0.32	E	ditto	ditto scud and ditto	Clouds low—very dark.
	11		29·82	.....	0.273	42	41	1	3·101	3·106	3·214	..	41	38	0.05	..	11	0.07	.....	ditto	overcast	Very dark.
13	9		29·78	.....	0.245	44	38	6	2·772	2·803	3·452	..	..	....	....	..	12	0.31	NE	brisk	cumulo-strati	Overcast.
	4		29·73	.....	0.305	45	44	1	3·446	3·452	3·570	45	..	....	....	..	..	0.05	.....	ditto	ditto	Ditto.
	10		29·73	— 0.16	0.305	44	44	..	3·452	3·452	3·452	..	41	38	....	..	12	....	.....	ditto	overcast	Very dark—much rain in the night.
14	10		29·75	.....	0.294	43	43	..	3·326	3·326	3·326	..	..	....	....	..	14	....	.....	little	stratus.....	Overcast and very damp—sun broke through for two hours.
	4		29·75	.....	0.283	44	42	2	3·202	3·214	3·452	45	..	....	....	..	..	0.09	.....	ditto	ditto.....	Overcast and damp.
	10		29·75	+ 0.02	0.283	44	42	2	3·202	3·214	3·452	..	41	40	....	..	13	0.09	.....	calm	ditto.....	Ditto and very dark.
	9		29·72	.....	0.305	44	44	..	3·452	3·452	3·452	..	..	....	....	..	14	....	W	ditto	fog.....	Dark and foggy—great damp upon every thing.
	4		29·65	.....	0.328	46	46	..	3·699	3·699	3·699	46	..	....	....	..	..	....	.....	ditto	ditto.....	Ditto ditto ditto.
	10		29·57	.....	0.339	47	47	..	3·815	3·815	3·815	..	41	38	0.10	..	14	....	.....	ditto	overcast	Steady rain from five o'clock.
16	9		29·50	.....	0.273	41	41	..	3·106	3·106	3·106	..	..	....	....	..	15	....	N	little	ditto.....	Steady rain.
	4		29·41	.....	0.263	40	40	..	2·999	2·999	2·999	41	..	....	....	..	..	....	.....	ditto	stratus.....	Incessant rain and fog.
	10		29·40	— 0.35	0.229	36	36	..	2·629	2·629	2·629	..	36	38	0.49	..	14	....	.....	ditto	overcast	Gentle rain.
17	9		29·61	.....	0.283	42	42	..	3·214	3·214	3·214	..	..	....	....	..	13	....	NE	brisk	stratus.....	Small rain.
	4		29·73	.....	0.294	43	43	..	3·326	3·326	3·326	43	..	....	....	..	..	....	.....	ditto	ditto.....	Ditto all day.
	10		29·91	.....	0.294	43	43	..	3·326	3·326	3·326	..	40	38	0.09	..	15	....	.....	high	overcast	Very dark.
18	9		29·99	.....	0.214	42	34	8	2·399	2·438	3·214	..	..	....	....	..	11	0.43	E	ditto	cumulo-stratus.....	Morning very fine.
	4		30·01	+ 0.61	0.209	41	32	9	2·276	2·317	3·106	42	..	....	....	..	..	0.45	.....	ditto	ditto	Very fine and fresh.
	10		30·00	.....	0.193	33	31	2	2·232	2·240	2·393	..	31	27	....	..	9	0.08	.....	brisk	none.....	Night cloudless.
19	9		29·91	.....	0.207	34	33	1	2·389	2·393	2·438	..	..	....	....	..	10	0.04	NE	ditto	stratus-cumulo-stratus	Morning overcast.
	4		29·83	.....	0.193	36	31	5	2·218	2·240	2·629	37	..	....	....		..	0.24	E	little	ditto ditto and fog	Overcast with fog.
	10		29·86	.....	0.193	36	31	5	2·218	2·240	2·629	..	33	30	....		9	0.24	.....	calm	overcast	Overcast.
20	9		29·66	.....	0.162	35	26	9	2·501	2·545	1·897	..	..	....	....		..	0.32	NW	brisk	cumulo-stratus and haze	Morning fine—very cold.
	4		29·40	.....	0.221	36	35	1	2·538	2·545	2·629	36	..	....	....		..	0.04	WS	ditto	cirro-cumuli and mist	Overcast at twelve.
	10		29·12	.....	0.283	42	42	..	3·214	3·214	3·214	42	37	29	....		..	....	.....	little	overcast	A little sleet.

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METEOROLOGICAL JOURNAL—*concluded.*

Date. 1819.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. On a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
Nov. 21	10		29.08	—0.93	0.954	40	29	1	2.835	2.900	2.999	..	..	....	....	..	..	0.07	NW	little	cirro-cumuli	Rain in the night—morning fine.
	4		29.13	.....	0.973	41	41	..	3.106	3.106	3.106	41	..	....	....	..	..	....	NW	ditto	cumulo-stratus and stratus	Showers of small rain.
	10		29.33	.....	0.214	36	34	2	2.496	2.496	2.629	..	28	28	....	..	..	0.07	N	brisk	ditto ditto	Clearing.
22	9		29.46	.....	0.186	32	30	2	2.154	2.162	2.317	..	..	....	....	..	..	0.06	.....	little	haze	Morning very fine—sharp frost.
	4		29.49	.....	0.200	34	32	2	2.326	2.317	2.436	35	..	....	....	..	..	0.08	NW	brisk	few cumulo-strati	Day fine but hazy.
	10		29.54	.....	0.186	30	30	..	2.162	2.162	2.162	..	26	18	....	..	..	....	.....	calm	mist	Night very fine.
23	9		29.68	.....	0.168	29	27	2	1.958	1.958	2.096	..	..	....	....	..	..	0.05	.....	ditto	haze	Very white frost—morning very fine.
	4		29.72	.....	0.186	33	30	3	2.156	2.162	2.393	34	..	....	....	..	..	0.09	.....	little	cirro-cumuli and stratus	Day beautiful.
	10		29.74	.....	0.180	29	29	..	2.096	2.096	2.096	..	23	15	....	..	..	....	.....	calm	none	Perfectly clear—immense deposition of moisture.
24	9	D	29.81	.....	0.156	27	25	2	1.804	1.831	1.959	..	..	....	....	..	..	0.05	.....	ditto	haze	Very white frost.
	4		29.89	.....	0.207	36	33	3	2.378	2.393	2.629	36	..	....	....	..	..	0.11	.....	brisk	ditto and cirro-strati	Beautiful day—frost not off in the shade.
	10		29.94	+ 0.86	0.200	32	32	..	2.317	2.317	2.317	..	28	20	....	..	..	....	.....	calm	ditto	Night very fine—immense deposition of moisture.
25	9		29.92	.....	0.193	31	31	..	2.240	2.240	2.240	..	..	....	....	..	..	. ..	.....	ditto	fog	Morning fine but foggy—very white.
	4		29.86	.....	0.207	34	33	1	2.389	2.393	2.436	36	..	....	....	..	..	0.03	.....	little	cirri and mist	Day nearly cloudless.
	10		29.78	.....	0.193	31	31	..	2.240	2.240	2.240	..	28	21	....	..	..	....	.....	ditto	dense fog	Fog—great deposition of frozen moisture.
26	9		29.64	—0.30	0.221	36	35	1	2.538	2.548	2.629	..	..	....	....	..	..	0.04	NE	brisk	stratus	Rain in the morning, which froze on the ground as it descended.
	4		29.67	.....	0.227	37	37	..	2.717	2.717	2.717	37	..	....	....	..	..	....	N	little	ditto and fog	Overcast—small rain.
	10		29.76	.....	0.227	33	33	..	2.389	2.393	2.389	..	32	27	0.15	..	..	....	.....	ditto	fog	Moon and stars dim.

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Art. XV. *Proceedings of the Royal Society.*

The sittings of the Royal Society were resumed on Thursday, November 4th, at which meeting the Croonian Lecture, by Sir Everard Home, was read. It consisted of a further investigation into the component parts of the blood.

Thursday, November 11th and 18th.—The Bakerian Lecture was read, "On the Composition and Analysis of the inflammable gaseous Compounds, resulting from the destructive Distillation of Coal and Oil, with some Remarks on their relative heating and illuminating Powers. By W. T. Brande, Esq., Sec. R.S." In this Lecture, Mr. Brande details a series of analytical and synthetical experiments on the gases mentioned in the title, which lead him to infer that there exists no other definite compound of carbon and hydrogen than *olefiant gas*, and that what has usually been termed light hydrocarbonate, is merely a mixture of olefiant and hydrogen gases; consequently, affording varying results when submitted to analysis. Mr. Brande refers the sulphureous odour which is frequently perceived during the combustion of coal gas, in which no sulphuretted hydrogen can be detected, to the presence of sulphuret of carbon. This lecture also contains a detailed inquiry into the relative heating and illuminating powers of olefiant gas, and of the gases afforded by the destructive distillation of coal and oil, and concludes with some comparative researches on the properties of solar and terrestrial radiant matter.

Thursday, November 25th. A paper was communicated by Dr. Young, entitled, "On the Elasticity of the Lungs," by James Carson, M.D.

Tuesday, November 30th. This being St. Andrew's day, the Society met according to annual custom, for the election of officers, which the Scrutators, having examined the lists, declared as follows:—

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PRESIDENT.—The Right Hon. Sir Joseph Banks, Bart., G.C.B.

TREASURER.—Davies Gilbert, Esq., M.P.

SECRETARIES.—William Thomas Brande, Esq.
Taylor Combe, Esq.

COUNCIL.

Right Hon. Sir Joseph Banks, Bart., G.C.B., *President.*
William Blake, Esq.
William Thomas Brande, Esq., *Secretary.*
Earl Brownlow.
Samuel Goodenough, Lord Bishop of Carlisle.
Earl of Charleville.
Taylor Combe, Esq., *Secretary.*
Alexander Crichton, M.D.
Davies Gilbert, Esq., *Treasurer.*
Major-General Sir J. W. Gordon, K.C.B.
Sir B. Hobhouse, Bart.
Sir Everard Home, Bart.
Captain Henry Kater.
Daniel Moore, Esq.
Right Hon. Sir John Nicholl.
John Pond, Esq.
Rev. Thomas Rackett.
Sir J. Staunton, Bart.
Right Hon. Charles Yorke.
William Hyde Wollaston, M.D.
Thomas Young, M.D., *Secretary for foreign Correspondence.*

Thursday, December 9th. At this meeting, a paper was communicated, "On the Polarisation of Light," by J. F. W. Herschell, Esq., F.R.S., the reading of which was continued on Thursday the 16th, and terminated on Thursday the 23d instant. The Society then adjourned for the Christmas vacation.

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Art. XVI. *Proceedings of the Horticultural Society.*

In a former Number, we promised to notice regularly the proceedings of this interesting and highly useful society, which, through the energy of its management, and the fascinating nature of the objects to which its attention is directed, has, in a few years, attained a consequence and stability that may rank it with the first societies in the kingdom.

We now proceed to fulfil that promise, and shall commence with the fifteenth anniversary of the society, held on the 1st of May, 1819. On this occasion it was removed from the apartments of the Linnean Society in Gerrard-Street, where its meetings had been hitherto held, to a very commodious house and spacious meeting-room of its own in Regent-Street. The business of the anniversary is principally the election of officers, and the members of the council for the ensuing year. On this occasion all the officers were re-elected; and no other change was made in the council than that which the laws of the society enjoin, namely, the removal of three in rotation.

After the proceedings had closed, near a hundred members dined together at Almack's Rooms, in King-Street, St. James's. When the cloth was removed, a Report on the state of the society was read, by which it appeared that the total number of the society on that day was 601, of which 220 had been elected in the preceding year. It also appeared that the society had presented twenty silver medals within the year to different persons for their skill in various branches of Horticulture.

At the meeting of the 18th of May, a paper by Mr. William Masters, jun., was read, on the various species of the Genus Phlox, in which, after distinguishing the different species and varieties, Mr. Masters gives practical directions for their cultivation.

A paper descriptive of an improved frame for forcing vines was read, communicated by Sir Robert Vaughan, bart.; together with a model of the frame. The difference of this frame

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from those generally constructed, is in its having a double groove for the sash to slide in. When the forcing of vines is over, the sash is withdrawn from the upper groove, and inserted in the under one, by which means the vine is put out of doors, and the forcing of other matters in the frame goes on.

Amongst a brilliant shew of flowers and fruits were fine specimens of grapes, sent from the garden of Benjamin Benyon, esq., M. P., of Haughton Hall, near Shiffnal. A branch of the Loquas, in fruit, was sent by Earl Powis, from his garden at Powis Castle, Montgomeryshire.

At the first meeting in June several interesting papers were read, particularly one on the steam-pits, erected by Count Zubow at St. Petersburg, by Dr. Fisher, inspector of the botanic garden at Gorinki, near Moscow, a foreign member of this society. These pits are for the general purposes of forcing, but more particularly for pines; they are filled with earth instead of tan, and are heated by passing a perforation steam-pipe through a reservoir of water, occupying the whole space beneath the pit, and the water being heated by this means, communicates its heat to the earth above, through perforated planks, and raises it to a high temperature; and it retains its heat so well that the fire may be discontinued for some days without injury to the plants.

A communication from Dr. Hill was read on the use of oxygen gas in the growth of plants. Dr. Hill has proved by frequent experiments, that water impregnated with oxygen gas applied to the roots of plants in a feeble state of growth will rapidly effect a change, and produce luxuriant vegetation.

An official letter was read from Dr. Wallick, superintendent of the botanic garden at Calcutta, and a foreign corresponding member of the society, addressed to C. Lushington, esq., secretary of government at Calcutta, and communicated to the society by order of the directors; stating, that he had, in consequence of the instructions of the court of directors, taken such steps to collect plants and seeds in the interior of India for the Horticultural Society, as led him to hope for the most beneficial results. The letter was accompanied by a list of a

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great number of varieties of seeds, which were received at the same time with it, as were also two boxes of plants.

A great variety of early fruits were exhibited, as were also some fine golden-pippins kept from last season.

June 16th. The most interesting of the papers read this day was one on the country where the apricot-tree grows wild, translated from the French of M. L. Regnier, by Richard Anthony Salisbury, esq., F.R.S., &c. In this paper M. Regnier controverts the received opinion that the apricot is a native of Armenia; and conceives, from the nature of the tree, from the observations of some ancient writers, and from his own inquiries while in Egypt, that it is found in a wild state only in the fertile spots in Africa.

A profusion of choice flowers, and of strawberries, cherries, and other fruits were exhibited.

At the first meeting in July, a communication was read on all the varieties of the Spring radish, founded on observations made at the garden of the society where all the varieties had been cultivated.

A communication from Mr. William Masters, jun., of Canterbury, was read, pointing out a method of obtaining bulbs of the Iris Xiphioides from seed, little inferior in size and vigour to those imported from Holland. Mr. Masters also obtained as many varieties in colour as arise from Dutch roots.

A very brilliant assemblage of flowers and fruits was exhibited, and particularly specimens of fourteen varieties of grapes, all of great beauty and excellence, grown in the vinery of George Caswall, esq., at Sacomb Park, Hertfordshire.

July 20th. The President sent specimens of a new cherry of great excellence raised by himself, the produce of a tree only three years old. Numerous varieties of the fruits in season were tasted, particularly a lemon queen pine, sent by the Right Hon. Sir Joseph Banks, bart., which was much commended.

August 3d. The silver medal of this society was presented to George Caswall, esq., for the splendid exhibition of grapes made by him on the 6th of July.

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Directions by the President, for a more successful method of cultivating the Guernsey Lily was read.

A proof of the efficacy of transplanting onions was shewn by Mr. David Anderson, gardener to the Viscount Montague, at Ditton Park. The onions were sown in September 1818; some were transplanted the first week in the succeeding March, and others suffered to remain in the seed-bed. The two sorts were shewn, and the transplanted bulbs more than tripled in size and weight those which were suffered to remain.

Mr. Richard Williams of Turnham Green, also exhibited three onions sown in October, and transplanted in the spring, which together weighed three pounds four ounces.

A very fine pine, called the Welbeck Seedling, sent by the Right Honourable Sir Joseph Banks, Bart., was tasted, and greatly admired.

The Blood Red Pine, a very handsome variety, grown by Mr. John Wilmot of Isleworth, was tasted, as were numerous specimens of almost every fruit in season.

August 17th. An account was read of the Fig-tree, planted in 1648, and which is now growing in the garden of Christ Church College, Oxford, by Mr. William Baxter, curator of the botanic garden at Oxford, and a corresponding member of the Society.

A description was also read of two very extraordinary trained mulberry-trees, now growing in the gardens of Thomas William Coke, Esq., M. P., at Holkham Hall, Norfolk.

A very great profusion of fine fruits was tasted; amongst them were specimens of the figs from the Pocock fig-tree at Oxford, and from Cardinal Pole's fig-tree, growing in the garden at Lambeth Palace.

September 7th. An account of a new strawberry, raised by the President, was read. This variety is described as being a great acquisition, from its large size and beauty, and from its exquisite high flavour.

An account was also read of a successful method of raising large onions, by planting small bulbs early in the year, by Mr. John West, gardener to the Marquis of Northampton.

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Six onions, grown in the garden of Roger Wilbraham, Esq., were exhibited, to shew the advantage of transplanting; they weighed together, eight pounds four ounces; were remarkably flat in their form, firm, mild in flavour, in every respect equal to the imported Portugal onions.

Three onions were also exhibited by Mr. Samuel Rontaul, gardener to the Earl of Liverpool, at Walmer. They were grown from English seed, and cultivated on the Portuguese plan, which has been described in the Society's Transactions. The three weighed five pounds, the largest one pound nine ounces.

An extraordinary display was made at this meeting of all the varieties of peaches, plums, and apples in season, sent from various parts of the kingdom.

September 21st. The silver medal of the Society was presented to Mr. David Anderson, gardener to the Viscount Montague, at Ditton Park, for his skill in general cultivation, as proved by the various exhibitions of fruit and vegetables which he had made at different meetings of the Society.

Specimens of many varieties of Flemish pears and apples were shewn, received from M. Stoffels of Mechlin, a corresponding member of the Society. The display of peaches, grapes, and other fine fruits, was even superior to the preceding meeting. Several rare exotics, in flower, were exhibited.

October 5th. The silver medal of the Society was presented to Mr. George White, gardener to Benjamin Benyon, Esq., M. P.; to Mr. Samuel Rontaul, gardener to the Earl of Liverpool; and to Mr. Isaac Oldaker, gardener to the Right Honourable Sir Joseph Banks, Bart., for their skill in various departments of horticulture.

A very large collection of pears and apples, was announced as having been received from Dr. Van Mons, professor of botany at Louvain, and a foreign member of the Society, many of which were new in this country, and highly deserving cultivation. A large collection of pears, received from the garden of the Luxemburg, was announced; it contained all the best varieties of French pears, and proved highly useful in correcting many of the mis-

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nomers which have prevailed in this country. An infinite variety of fruits were exhibited, sent from various parts of the country.

October 19th. Numerous specimens of pears and apples, many of them of great excellence, were exhibited. The effects of ringing the branches of apple-trees, in enlarging the fruit, was exemplified in six varieties, sent by Thomas Hunt, Esq., of Stratford on Avon, F. H. S.

November 2d. Several fine collections of apples, pears, and other autumn fruits were exhibited, particularly a very numerous collection from Messrs. Shertzer and Son of Haarlem.

November 16th. A communication from John Livingston, Esq., of Macao, in China, a corresponding member of the Society, was read, on the difficulties which have existed in the transportation of plants from China to England, and suggestions for the removal of them. Amongst numerous specimens of pears, apples, &c., a very remarkable apple was shewn, grown near Lewes, in Sussex. It weighed 23 ounces and three quarters, and measured 17 inches in circumference.

December 7th. Silver medals were presented to Mr. Robert Hedley, gardener to Thomas Meynell, Esq. at Yarm, near Stockton-on-Tees, and to Mr. Thomas Tanner, late gardener to Lord Henry Fitzgerald, for their skill in horticulture. A paper by the President was read on the effects of very high temperature, on some species of plants. Several varieties of seedling grapes were exhibited, raised by John Braddick, Esq. of Thames Ditton. Many of them were considered very fine.

The increase in the numbers of the Society is most remarkable, no less than 230 fellows having been elected since May, exclusive of several foreign members, and corresponding members.

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Art. XVII. *Miscellaneous Intelligence.*

I. Mechanical Science.

§ 1. Astronomy, Agriculture, the Arts, &c.

1. *Prize Question for* 1820.—The Royal Academy of Sciences of Naples proposes the following subject to be rewarded with a prize, in the year 1820.

The description of an instrument is required, 1. which shall unite in itself the properties of the largest and most perfect meridian circles and meridian telescopes that have yet been made; 2. the verification of which shall not depend on any spirit level; 3. which can traverse and turn with facility, so as to allow of observation in two contrary positions; 4. and which can be made by any good workman possessed of the means offered by the actual state of the arts.

The memoir, to be accompanied by designs of the instrument, may be written either in Latin or Italian.

The prize to be awarded for the successful execution of the above conditions, will be a gold medal of the value of six hundred ducats. The memoirs, without the name of the author, but distinguished by a motto, are to be sent before the termination of February, 1820, to Il Cav Teodoro Monticelli, Secretary to the Royal Academy, and enclosed to the Secretary of State for external Affairs. The prize will be awarded on June 30, 1820, and the Memoirs not approved of returned, on demand, to the authors.

2. *Rate of Increase in the Vegetation of Wheat.*—The following experiment was made in Sussex. In October, 1818, twelve grains of wheat were planted at six inches' distance from each other. They all vegetated, but one third was afterwards destroyed by the worms. The remaining crop having flourished, was reaped in the beginning of August, the eight grains producing 213 fine ears, or nearly 27 ears, of 39 grains each, from each seed sown. The crop being threshed and cleaned amounted to 12¼ ounces of corn. From this result, expanded by calculation over an acre of ground, are drawn arguments for

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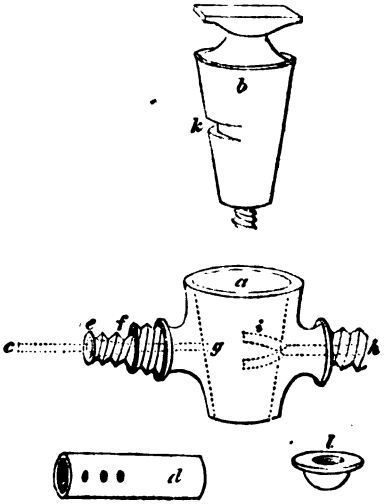
the more accurate culture of grain than is generally adopted in this country.

3. *New Stop-Cock for Pneumatic Apparatus.*—In consequence of the frequent imperfection of the common stop-cock for the retention of condensed atmosphere, Sig. Crivelli, Professor of Natural Philosophy at Milan, has invented another, which is supposed to be free from the objections that may be made to the first. The annexed diagram will explain its construction.



It consists of a box *a*, and plug *b*, both of the usual form; also a conical valve *c*, and a spring tube *d*. The aperture in the end of the stop-cock, from *e* to *f* is conical, and carefully ground. The other part inwards is cylindrical; the valve is a metal rod extending from *c* to *g*, and made conical in the part corresponding to the aperture just now described, so as to fit it with great accuracy. This valve is retained in its place in a shut position by a small spiral spring in the tube *d*, which tube screws on to the worm *e*. The side of the box corresponding to the other aperture *h*, has no appendage, but is finished by having a groove cut in its inside, nearly half way round *i*, and level with the valve and the aperture. The plug of the cock is not bored, but has a groove cut in it, *k*, deepest in the middle

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of its length, and passing off gradually into the general surface of the plug, so as to form a kind of inclined plane on it. This groove extends half way round, and is so arranged that when the plug is put into its place, it shall receive the end of the valve *c*, the length of the valve, and the depth of the groove being such that the former may perfectly enter into and close the conical aperture *e*, when its extremity *c* is in the middle of the groove. Now, it is evident, that whilst the cock remains in this state, it is shut against the passage of any gas through it, not only by the conical valve, but also by the disunion of the two grooves; when, however, the plug is turned, the plane, which the groove in it forms, presses on the end of the valve, and opens it either more or less, according as it is more or less turned round, and, at the same time, the end of the plug groove passing over the end of that in the box, opens a channel, by which the gas passes off, which has already made its way by the valve. The emission of the gas may, in this way, be regulated with great nicety, and its retention, if required, secured in a very perfect manner. The plug is retained in its place by the screw *l*, or, as in the usual manner; and, it is evident, that the end *e* of the stop-cock is that which is to be inserted into the vessel intended to contain the gas. Sig. Crivelli has particularly applied these stop-cocks to the condensed air blow-pipe.—*Giornale di Fisica.* T. 2., p. 92.

4. *Substitute for a Copying Machine.*—Write with common writing ink, in which lump sugar has been dissolved, in the proportion of four scruples or a drachm and a half of sugar to an ounce of ink.

Moisten copying paper, (a paper which is sold at the stationers at 1*s.* 10*d.* a quire for the Copying Machines,) by passing a wet soft brush over it; then press it gently between soft cap paper, so as to smoothen it and absorb the superabundant moisture.

Put the paper so moistened upon the writing, and both between cap or other smooth soft paper, placing the whole on the carpet or hearth-rug, one end of which is to be folded over it.

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By standing and treading upon this, an impression will be taken equal, if not superior, to what would have been taken by a Copying Machine.

Leicester. J. L. G.

5. ***Dry-Rot prevented.***—The following method of preventing dry-rot is recommended. This destructive visitant in dwelling-houses generally grows and originates in the cellar. If persons *white-washing* cellars will mix as much copperas with the wash as will give it a clear yellow hue, and repeat this every year, they may prevent the dry-rot, or stop its progress, if it has already appeared.

6. *Ancient Seeds.*—In the highest point of a field on the farm of Craignarthro', a mile south from Forfar, in Scotland, there was a druid's place of worship, consisting of a circle of large stones, with one, the largest, in the middle. The field was fallowed last year, and this temple trenched, from which a very great quantity of stones were turned up. Nothing particular, however, appeared, except a few bones that went to dust. The field, this year, was sown with barley, and this trenched part with the rest; now, so far as this space extended, there are considerable quantities of oats of various kinds, sprung up among the barley, the seeds of which, *must* have remained there more than 1,000 years. Without the trenched ground, there is not a head of oats to be seen. Orders have been given to preserve these oat-plants.—***New Monthly Magazine.***

7. *Smut in Wheat prevented.*—The following process is recommended in the *Bibliothèque Physico-Œconomique*, as the only one which experience has proved effectual against the smut in wheat. To destroy the germ of the blight in 4½ bushels, or 256 pounds of corn, about six or seven gallons of water must be used, according as the grain is more or less dry, and from 35 to 48 ounces avoirdupois of quick-lime, in proportion as it is more or less caustic, and according to the extent of the blight. Slack the lime in a portion of the water heated, and then add the rest. The heat of the whole quantity of

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the water should be just bearable by the hand. It is then to be poured upon the corn, placed in a tub, stirring it continually, at first with a stick, and then with a shovel. The fluid should, at first, cover the wheat three or four fingers' breadth, but it will soon be absorbed by the grain. It should remain in this state twenty-four hours, being turned over five or six times in the interval. Whatever fluid will drain off is then to be separated, and the seed, after standing a few hours, so that it may run freely out of the hand, may be sown. If not to be used immediately, it should be put in a heap, and moved once or twice a day till dry.

This grain germinates sooner than unlimed grain. It germinates with more certainty, and insects will not attack it.

II. Natural History.

§ 1. Mineralogy, Geology, &c.

1. *Mineralogical Notices, &c.*

Mr. Editor,—Sir,

During my late tour into Derbyshire, I was pleased at meeting with compact fluor, which has not before been noticed, to my knowledge, in that county; it occurs sometimes covered with beautiful cubic crystals of opalescent yellow fluor. Another variety has frequently been called *kevel.*

In a level driving from Castleton-town, in a west direction, to the Odin mine, and, in the stratum called *shale*, several small calcareous veins were cut; from one of them some fine crystallizations were obtained of the primitive rhomb, and from another, rushed a current of air of small magnitude, which inflamed when a lighted candle was applied to it. In one instance it burnt all night, but it was exhausted in a few days. Some years ago, perhaps thirty, I have heard of the miners selling specimens of green selenite; they occurred in the Odin mine: latterly, some very fine phosphates of iron have been met with in that neighbourhood: it is doubtful if what were called green selenite were not phosphates of iron. In the shale, this substance is common, appearing as a blue powder, but it is

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rarely crystallized, and, in appearance, very different from any that has hitherto occurred.

As the choak-damp is not common in Derbyshire, I was equally astonished and alarmed at being informed, that a young man, in going down a well, not four yards deep, nor narrow at the top, to see if any water was in it, had scarcely descended below the surface, before he fell from the ladder. A more elderly person immediately went down to give assistance, and shared the same fate. This unhappy accident happened in September, at Matlock Bank, in the shale or schistus stratum.

In the first limestone, a new substance has latterly been discovered, that has much the appearance of hyalite, it occurred in an opening in the magnesian limestone; and, latterly, some varieties of crystallized calamine new in Derbyshire, have been discovered near Matlock. The mine which produced the carbomuriate of lead so much desired, is not again likely to be worked. In making the road to Derby, a quantity of calc tuffa was cut through which, from its situation, must have been deposited by the springs above, as it is situated fifty feet above the level of the river, a great deal of this tuffa has been taken away to make grottoes, for which it was admirably adapted.

The mine at Castleton, which produces the beautiful fluor appears nearly exhausted, as, by going deeper, it becomes so inferior as not to be worth working.

Some very large vases and pedestals have lately been made of the black marble at Ashford, belonging to the Duke of Devonshire, which are placed in the grand room at Chatsworth, and have a fine effect.

I am, *&c.*, J. Mawes.

2. *Boracic Acid.*—M. Lucas, in a letter to M. Arago, describes the occurrence of boracic acid in the crater of Vulcano. It is found on the surface, at the parts most heated, and where vapours are continually rising. It occurs in a very white light state, though sometimes soiled, and sometimes mixed with sulphur. The crusts are generally about

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three quarters of an inch in thickness, and sometimes above a foot in extent. It occurs in scales, and sometimes fibrous. Their nature was ascertained by D. Gioacchino Arrosto of Messina.

3. *Magnetic Iron Ore.*—The following fact respecting the magnetic iron ore of Succusunny, belonging to Governor Dickerson, of New Jersey, is stated by Colonel Gibbs, in *Silliman's Journal.*

" The proprietor, a gentleman of distinguished science, informed me of a singular circumstance attending it, which was too important to be left unnoticed. The mine is wrought to the depth of one hundred feet; direction of the bed, north-east and south-west; inclination nearly perpendicular; the ore in the upper part of the bed is magnetic, and has polarity: but that raised from the bottom has no magnetism at first, but acquires it after it has been some time exposed to the influence of the atmosphere."

4. *Analysis of the Wavellite.*—According to M. Berzelius' late experiments, wavellite contains:—

Alumine	35.35
Phosphoric acid	33.4
Fluoric acid	2.06
Lime	.5
Oxides of iron and manganese	1.25
Water	26.8
	99.36

5. *Fossil Animal Remains.*—Some labourers in the department of Lot have lately penetrated into the caverns formerly dug by the English in the vicinity of Breuge. In the lowest part were certain crevices, which when laid open, discovered a depository of bones, some of horses, others of the rhinoceros, of the same species of which fossil fragments have been found in Siberia, Germany, and England; and a third kind belonging to a species of stag, now a non-descript, with horns not much unlike those of a young rein-deer. These relics have been col-

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lected, and presented to the Academy of Sciences, by M. Cuvier, and are now in the King's Cabinet.

6. *Lignite.*—M. Becquerel has examined and published an account of a stratum of fossil-wood, occurring at Auteuil, in the neighbourhood of Paris, which seems of great extent. It contains interspersed here and there succinite, and crystals, supposed to be of mellite; but the exact nature of which has not been ascertained.

"This stratum of lignite contains trees still entire in their forms, some of considerable length, and varying in diameter from six to eighteen inches. The space between them is filled with a black sulphureous and bituminous clay. They are penetrated by pyrites, which are sometimes so abundant as entirely to replace the ligneous part, and which decompose with great rapidity on exposure to the air. Sulphur is found there in a pulverulent form, and there are also saline efflorescences. Succinite occurs in rounded pieces from the size of a millet-seed to that of a hen's egg. It is yellow and transparent, but the workmen sometimes find it whitish, yellow, and translucid. That which I collected at the place from amongst the lignite was perfectly transparent. There is found also in this stratum, a crystalline substance, of which the existence will be interesting to mineralogists and geologists, for, if not mellite, it is a new substance. It is found in small honey-yellow crystals transparent, and adhering either to the surface of the lignite, or occurring in its interstices. These crystals, though very small, are very perfect and regular; they occur generally on the portions containing least pyrites. They are found sometimes in the same piece with the succinite. They are of various forms; the most common are the octoedron, which appears to me regular, the acute octoedron, and the transposed octoedron, a form which has not yet been observed in the mellite. This circumstance, and that of the form which appears to me a regular octoedron, induce me to suppose, that it ought not to be confounded with the mellite. It may be named provisionally *xylocryptite*, expressive of its being hidden in fossil wood."

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" Immediately beneath the lignite, a bank six feet in thickness occurs, of the nature of chalk; and in which the works have ceased. In some places, as at the vineyards of Auteuil, the chalk occurs immediately after the clay."

The lignite is peculiarly situated; all the trunks are in the same direction, nearly perpendicular to the banks of the Seine, and inclined to the horizon. This circumstance suggested the idea that traces of it might be observed when the waters were low, in the banks of the river; and it appears that enormous trunks of trees are actually found on the corresponding bank, and in the bed of the river. They differ in their nature from the lignite, but this is conjectured to be caused by the continual action of the water.

This fossil wood is first found opposite the road to Autueil, where it joins the main road to Sèvres, and from thence, in descending the river about a quarter of a league; but there is no trace of it up the river. Nor is any fossil-wood found on the right bank of the Seine, in a direction perpendicular to it, beyond the limits assigned to the county where the lignite is found.

The bones of large animals are frequently found in the black clay which precedes the lignite. In digging a well lately, at the house of M. Fortin, the labourers endeavoured in vain to remove a large skeleton, with which they came in contact, in consequence of the extent it occupied. Fossil shells are also abundant in the lignite. Hence, and from the position of the trunks, M. Becquerel supposes it possible that a great irruption from the south-west may have caused the overthrow of a forest giving rise to the lignite; and that the bones belonged to the animals which inhabited it. The idea is supported by a quotation from M. M. Cuvier and Brogniart, in which they notice the general marks of such an irruption. M. Becquerel also supposes that the succinite may be the resin of those trees, and thinks that its dissimilarity with the resins now known, does not oppose the idea; since, as there are many remains of extinct kinds of animals, there may be the same also of resins.—*Journal de Phys.* 89, p. 237.

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7. *Royal Geological Society of Cornwall.*—SIXTH ANNUAL REPORT OF THE COUNCIL.—The state of comparative maturity to which the society has now arrived, affords less interesting matter for remark than during its early progress. The council, therefore, in discharging this their annual duty to the members, have little left them to do, but to call their attention to the respectable rank which the institution has attained; and to urge the necessity of their continued patronage to ensure its stability.

Independently of the intrinsic advantages of an institution of this kind, in gradually adding, by the labours of its members, to the knowledge of the physical structure of Cornwall; it possesses a secondary value, by attracting to this part of the county individuals eminent for their genius and scientific acquirements, whose presence cannot fail to be useful to any place which they visit.

Owing to expenses incidental to the completion of a new museum, the funds of the society have not, as was expected, as yet justified the addition, by purchase, of any new minerals to the cabinet; neither have the donations been so numerous and splendid as last year. The society has, however, been favoured with not a few specimens, as well from members as others.

The communications on geology, and the branches of science connected with it, have been numerous and valuable; and the quantity of information contained in several of these respecting the structure of the county, and its mineral repositories, renders it the duty of the council to lay them before the public as soon as materials for a second volume are accumulated, a period probably at no great distance.

The council regret that the backwardness of many of the members, who have it most in their power, to forward some of the most interesting objects of the institution, justifies, and, indeed, renders necessary, the repetition of the following appeal to their liberality and zeal.

"The council cannot avoid expressing their regret, that so few new specimens have been obtained from the county mines; and that, consequently, the department of the cabinet set apart for

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the reception of indigenous ores, which ought to be particularly rich and splendid, continues to be defective, and is eclipsed by many other collections, as well public as private; a circumstance uniformly exciting the surprise of strangers.

" The council earnestly request the attention of members to the grand object of the institution, that, namely, of enlarging our knowledge of the geological structure of Cornwall. It is impossible for a few members to undertake the investigation of the whole county. It is therefore hoped, that, with a view of enabling the society to complete its long-promised, but still very defective geological map, members will, in their respective districts, endeavour to ascertain the nature and relations of the rocks; and transmit their observations made, and specimens collected, from time to time, to the secretary, who will be very ready to assist their inquiries by any advice or information in his power. Any person, even although unacquainted with the principles of geological science, can, it is obvious, collect specimens of the various rocks in his vicinity; and members are requested to bear this in mind, with the assurance that collections of this kind, with the various *localities* of the specimens affixed, will very materially promote the important object in view. One grand *desideratum*, and which might be very easily supplied by members resident in the different parts of the county, is,—to ascertain the exact *limits of the different Granite and Killas districts.* The farmers and miners, in any part of Cornwall, could give this information to any gentleman that would take the trouble to record it, or to trace the boundary lines in any of the county maps.

By Order,

Sept. 21, 1819. JOHN FORBES, *Secretary.*"

8. *Earthquakes.*—Three severe earthquakes took place at Copiapo, on the 3d, 4th, and 11th, of April. The whole city is described as being destroyed by them; and the inhabitants appear to have had time only to save their lives. Copiapo is a sea-port of Chili, and stands on the south side of a river of the same name, about 490 miles N. by E. of Valparaiso.

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A severe shock of an earthquake was felt in Trinidad on the 12th of August, at half-past two A.M. A rushing noise, as of wind, was first heard, which was instantly succeeded by an undulatory motion, from east to west, very severe, and lasting four or five seconds. It was a clear moonlight night, and nothing particular appeared in the state of the atmosphere.

A shock, accompanied with a loud explosion, was felt on the 15th of August, at the village of St. Andrews, in Lower Canada.

A dreadful earthquake has occurred in a part of the world in which such phenomena have been extremely rare. The whole district and territory of Kutch, a country situate to the N.W. of Bombay, including several towns and villages, has been destroyed. The entire city of Bhoog, the capital, has become a heap of ruins, under which were buried 2,000 of the inhabitants. This event occurred on the 16th of June. Among the towns that have suffered, are Mandarie, Moondar, Anjar, and Baroda. The earthquake extended northward as far as the city of Ahmedabad, where it did much harm. It was also slightly felt at Poonah, 400 miles from Ahmedabad; and its power extended considerably on each side of the line between those cities. The shocks occurred on several successive days. The first which took place at Baroda, lasted between two and three minutes, without intermission. On the 17th one occurred, on the 18th two, and on the 20th two. The British troops, under the command of Sir W. Keir, were encamped in the midst of this dreadful convulsion, but escaped, fortunately, without much injury.

Three shocks of an earthquake occurred at St. Thomas's, during the hurricane which blew there October the 19th and 20th.

9. *Scintillating Limestone.*—A peculiar limestone occurs in Vermont, New York, a primitive country. It is of a pale sky-blue colour; effervesces strongly with nitric acid, and by burning produces lime. But it gives forth sparks with steel—this was concluded at first to be accidental; but every specimen tried from various parts of the country, uniformly gives fire

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with steel. It is found in layers, blocks, and masses, disseminated among the clay slate that covers the greatest part of the townships in that vicinity. When first taken from the earth, and exposed to the air, it is covered with an incrustation of a dark reddish-brown colour, that crumbles easily between the fingers; and is generally from one inch to a foot in thickness. This incrustation hardens on long exposure to the air. This led to a supposition, that the incrustation was owing to the decomposition of the limestone by sulphuret of iron, intimately disseminated through the rock; which would also account for the singular circumstance of its striking fire. But, on dissolving a portion in nitric acid, and adding a decoction of gall nut, no discoloration was produced.—*Silliman's Journal* I., p. 241.

10. *Native Lead and Cinnabar, in America.*—Dr. Conistock, in a letter to Dr. Silliman, gives the following account from M. Stickney of these minerals.

M. Stickney states, that the situation of Fort Wayne, and the surrounding country, is a high level, probably about 800 feet above the level of the sea. From this place the water-courses divide, and take different directions; on the one hand falling into the gulf of Mexico, and on the other into the bay of St. Lawrence. The whole country is of secondary formation, chiefly calcareous and aluminous.

Bitumen and sulphur are every where to be found, and as usual, accompanied by the metals.

In speaking of the cinnabar, his words are, "I have found a black and garnet-coloured sand, in great abundance, on the shores of the lakes Erie and Michigan; this is a sulphuret of mercury, and yields about 60 per cent. It is so easy to be obtained, and in so convenient a form for distillation, that it must become an important article of commerce."

The native lead was found on the Anglaise river, at a considerable distance from the fort.

Of this he says, "Metallic lead is so interspersed with galena, as to prove incontestibly the existence of native lead."

11. *Aurora Borealis.*—A very remarkable meteor of this kind

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appeared in the evening of October 17th. Seen from Seathwaite, in Borrodale, Cumberland, it formed, about 9 o'clock, an arch extending from east to west nearly, having its higher part inclined towards the south. About 9h. 15′, its extremities had moved 12 or 13 degrees northwards, and the whole arch was vertical, being in a plane passing through the magnetic east and west. About 9h. 30′, it had retired to its former place and inclination, and afterwards gradually diminished in intensity, until it disappeared. Even small stars were visible through it the whole of the time.—*Tilloch. Mag.* 54, p. 383.

§ 2. Medicine, Anatomy, &c.

1. *New Mercurial Ointment.*—Mr. Donovan has lately published, in the *Annals of Philosophy*, a series of experiments on the compounds of mercury. They relate to the chemical constitution of these compounds, and the proportion of their elements; but are concluded by an examination of the common mercurial ointment, and an account of a new one.

Four troy ounces of mercurial ointment were kept at 212° for some time; they separated into two strata; when cold, the upper stratum, of a light grey colour, was separated; the under stratum was exposed at 212° on blotting paper, which absorbed the remaining lard. The very heavy residue was triturated with a little magnesia, and immediately gave 495 grains of mercury; further trituration with magnesia gave 225 grains more. The earthy mass, treated in different ways, gave a quantity of globules, estimated at 60 grains, and a little oxide appeared. Thus, out of 960 grains, contained by the 4 oz. of ointment originally, 770 grains were collected, leaving 190 grains, the quantity of mercury, apparently oxidized, or 47½ to each ounce.

The upper stratum appeared to contain oxide of mercury in chemical combination; and Mr. Donovan believing that the metallic mercury could have no effect on the animal economy, attributed the powers of the ointment to the small quantity of oxide with which the fat is combined. To ascertain if this were the case, this upper part was given to three females requiring the use of mercury. Each rubbed in a drachm every night;

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one was affected by the third rubbing, and the fourth put her under ptyalism. Another, after rubbing three times, was so salivated, that she spit two quarts in twenty-four hours, and this, in a less degree, was kept up for ten days. The third was not affected until she rubbed six times, and then not considerably. They were all at length recovered.

Finding the ointment so very active, Mr. Donovan conceived, that by forming a chemical union between fat and oxide of mercury, in very small quantity, the same result might be obtained; lard and black oxide of mercury were, therefore, kept at the temperature of about 350° for two hours, continually stirring them. At the end of the process, it appeared that every ounce of lard had dissolved, and united with twenty-one grains of oxide.

This ointment was tried on many persons, and found to be as active as the common mercurial, containing twelve times the mercury. One drachm could be rubbed in completely, in from six to ten or fifteen minutes, whilst common ointment required thirty or forty minutes, and rarely was any eruption produced on the part rubbed. The use of it is extremely cleanly, and its expense is very much below that of the common ointment.

For the preparation of this ointment, it is essential that the lard be entirely free from salt, or else calomel will be formed. The oxide may be prepared by decomposing calomel by pure potash, or by pouring solution of nitrate of mercury into caustic alkaline solution.

The fat only dissolves three grains of oxide for each drachm, but the quantity in the ointment may easily be increased. The oxide should be first triturated with a little cold lard, to make the penetration complete.

The degree of heat applied is important. At 212° the oxide and lard will not combine. At 600° the oxide will be decomposed and mercury volatilized. At 500° and 400° the oxide is partially decomposed, some red oxide being formed, and mercury reduced. The best heat is between 300° and 320°; it should be maintained at least an hour, and the ointment should be stirred till cold.

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This ointment is now undergoing extensive trial, and the results are very favourable. Already several testimonies have been given by medical men to its value.

2. *Method of preparing Extracts.*—Mr. Barry has lately taken out a patent for the preparation of extracts by evaporation *in vacuo*. The evaporating pan, of polished iron, is converted into a still, by being closed at top, and its beak, or pipe, is led away to a copper sphere, which is the condenser: the connexion between the two being made, or closed, by a stop-cock. Both the still and the condenser are placed in vessels intended to hold water; the first being a water bath, the second a refrigeratory. The juice, or infusion, being introduced into the still, and all perfectly closed, water is poured into the vessel containing it until the still is covered; then the cock between it and the condenser being shut, steam is thrown into the condenser until all the air is expelled; the cocks are then closed, and cold water being poured on, a vacuum is produced; the connexion is then opened between the condenser and the still, and the former being four times the capacity of the latter, a considerable exhaustion is produced in it; the cock is then closed, steam is again sent into the condenser, and the exhaustion made as before; and this is repeated four or five times, until the barometer gauge attached rises to about twenty-eight or twenty-nine inches; steam is then introduced into the water bath, and the still heated, and the condenser being kept cool, rapid ebullition goes on at a temperature little above 95°. There is a barometer gauge to ascertain the exhaustion, a thermometer in the still-head for the heat, and also a strong glass window in it to shew the state of things within. The action of this apparatus is so perfect, that the height of the mercury is frequently twenty-eight inches during rapid ebullition; and it is an usual thing to work with it at a height not two inches less than the barometer of the day. Extracts prepared in this way, appear considerably different from common extracts, and, in some cases, much stronger. It, however, will require some time before all the advantages of the apparatus, or the medicines prepared by it, can be known.

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3. *Urinary concretion in a Pipe.*—The concretion deposited upon the inside of a waste pipe, in the Glasgow Infirmary, through which urine only has passed for the last twenty years, has been analyzed by Dr. Thomson. It was about an inch in thickness, and resembled calcareous tufa.

25 grains yielded	Urea. *&c.*.....	1.0
	Albumen and sand ..	1.1
	Phosphate of lime ..	5.8
	Carbonate of lime ..	2.8
		10.7

About 4.3 of urea was supposed to be decomposed during the analysis, and the remainder of the loss is attributed to water.

4. *Prize Question.*—The Royal Academy of Sciences, at Paris, propose the following subject, to be adjudged in 1821.

"To give a comparative description of the brain in the four classes of vertebral animals, and particularly in reptiles and fishes; endeavouring thence to recognize the analogy of the different parts of this organ, marking with care the changes of form and of proportion they present, and following, as profoundly as possible, the roots of the cerebral nerves.

"It will be sufficient to make the observations on a certain number of genera, chosen in the principal natural families of each class; but it will be necessary that the principal preparations be represented by drawings, sufficiently detailed, that they may thence be reproduced, and their accuracy determined."

The premium will be a gold medal, value 3,000 francs, to be appropriated in the public sitting of the month of May, 1821. The time for the transmission of memoirs, written in French or Latin, is January 1, 1821. To be addressed to the Secretary of the Institute.

5. *Medical Prize Question.*—The Society of Practical Medicine at Paris, propose, as the subject of a prize, consisting of a gold medal, value 200 francs, to be adjudged at the last sitting, in the year 1820, the following question:—

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" Are the affections, of which traces are found in the abdominal viscera, after putrid or adynamic and ataxic fevers, the effects, the cause, or a complicated effect of those fevers?"

The memoirs, written in French or Latin, should be addressed, free of carriage, before the 1st of October, 1820, to M. Giraudy, Secretary of the Society.

6. *Remedy for Hydrophobia.*—Extract from a letter from Sig. A. M. Salvatori, of Petersburg, to Professor Morrichini, of Rome.

" I should also notice to you the discovery made by me last year, during the time I was in the territory of Pultava, of a new method of curing the hydrophobia. I shall be happy if I can contribute to save the life of any one, from among the many who annually fall victims to this dreadful malady.

" The inhabitants of the district of *Gadici* have made, I do not know how, or when, the important discovery, that, in the neighbourhood of the ligament of the tongue of the man, or animal, bitten by a rabid animal, or of a man becoming rabid, whitish pustules appear, which open spontaneously, about the 13th day after the bite, the time at which they say the first symptoms of the true hydrophobia, till now judged to be incurable, appear. Their method consists in opening the above-mentioned pustules with a proper instrument, and making the person spit out the ichor and fluid, which run from them, washing the mouth frequently with salt water. This operation should be performed the ninth day after the bite. So efficacious is this method, that with these people the hydrophobia has lost its terrors. I only know of a single instance of which I cannot vouch the truth. I invite you, therefore, to verify this important discovery."—*Bibl. Ital.* xiv. 428.

III. Chemical Science.

§ 1. Chemistry.

1. *Researches on the Colours acquired by Metals when heated.*—These researches were made by Sig. Ambrogio Fusinieri, and are contained in the second volume of the *Giornale di Fisica*,

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p. 145. The author, after stating the object of his researches, namely, the cause and nature of the colours produced on the surfaces of metals, when they are heated, proceeds to show, what is generally known here, that they require contact of air for their formation. Wires, and bars of steel, *&c.*, were heated, part of some being immersed in mercury, part in the air, others when enclosed in the Torricellian vacuum, and in other situations, and it was found that no colour was produced when air was excluded, and that the tint was in proportion to its freedom of access. Concluding from hence, that the colours were occasioned by oxidation, some ingenious variations of the experiments were made. A wire of the gold of commerce was connected with the positive pole of a strong voltaic apparatus, and placed in water, opposite to a similar wire coming from the negative pole. After some hours, during which time the water had been decomposing, but which had occasioned no turbidness in the remaining portion, the point of the positive gold wire which had been exposed to the nascent oxygen, had acquired yellow, purple, and blue colours, as if it had been exposed to a flame. These were extremely distinct, when viewed by a lens. The negative wire which had developed hydrogen had not acquired any notable colour.

Platinum, in wire and laminæ, exposed at the same time, and under the same circumstances, with wires of iron, copper, silver, *&c.*, never acquired colour, though all the others did. This the author offers as an additional proof of their being occasioned by oxidation; and, after having drawn this conclusion from all his experiments, proposes the discoloration of a metal by heat, as an eudiometrical test of the presence of oxygen in mixtures of airs.

Sig. Fusinieri then proceeds to ascertain the order of production, and successive reproduction, of the colours. It is well known that, with iron and steel, the first colour that appears is yellow, to which succeeds a purple, inclining to violet, and at last deep blue, which passes into light blue. This order is attendant on the successive increase of temperature. The same order is constant with all the metals. To shew this, it is only necessary to

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put large wires of copper or silver, or small ones of gold, horizontally into a steady flame of alcohol. The colours will appear on the part at the flame, in the order mentioned, and pass outwards as the heat is conducted along the wire. In each metal that tint is most vivid which is like its own colour, and that least which is dissimilar to it. On iron the blue is bright and clear, whilst the purple is languid, and approaches to violet: on gold made into fine wires, the yellow is very bright: on copper the red and purple are fine, and the blue always light; on silver all the colours are equally lively. The best method of shewing the order of the colour is to place a piece of common tin-plate, very clean and bright, over the steady flame of a lamp. At first, a bright circle of fused tin is formed on the part just over the flame, in the middle of which a circle, of a gold yellow colour, soon appears, which, expanding, has, at last, a violet spot in its centre; this also expands outwards, and a blue tint forms in it, which, if also allowed to extend itself, the action of the flame being continued, will have the middle part converted into a whitish red scoria.

In certain circumstances, the successive reproduction of the same colours may be caused in the same order. Thus, after the light blue of the first series, follows yellow, then purple, then deep blue, and then again yellow, and so on. These successive series may be obtained on wires of silver, copper, and gold, heated by the flame of alcohol, and also on laminæ of steel, by means of hot charcoal. But the following is the best method to obtain many distinct series:

If thin leaves of copper or brass (Dutch metal,) be exposed to the flame of alcohol, so as to melt them, they readily burn. Care must be taken that only part of the leaf is burnt; this part retains its original form, but has become transparent. In all those places between the burnt and the metallic part will be produced parallel fringes, of very bright colours, which, when observed by a lens, present three or four series, in the order already mentioned. A small flame of hydrogen, forced from a bladder, through a fine tube, against a thin plate of silver, so as constantly to touch it in the same spot, gave systems of coloured

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concentric rings, which constantly possessed the same order. The external ring was darkish yellow, to which succeeded a deep red beneath a purple; and the third was a deep azure, which passed into a clear sky-blue; then returned the yellow, followed by the purple and the azure, and so on. These rings may be seen by the naked eye, but are best viewed by a lens. The number of series is not constant, being three or four, up to seven. They are always round a dark pulverulent central spot, which is an oxide of silver. All attempts to produce these rings on platinum failed.

Sig. Fusinieri remarks, after some other observations, that the colours farthest from the spot heated, are those first formed, and the nearest the last formed. Hence, the order in which they should be considered is from the external ring inwards. The first coloured zone is the largest, and it is larger as it is farther from the heated spot. The coloured rings, also observed by Newton between object glasses, and on soap-bubbles, vary in size; but with this difference, that they are always smaller as they recede from the centre, whilst the metallic tints are larger in the same situation.

If, in similar circumstances, a greater number of series be obtained, the zones are always narrower; and when the number is few, they are larger.

When there is a succession of series, the first is composed of dark yellow, dark red, dull purple, and dark azure, which passes into sky-blue. The colours of this first series become obscured by time, an effect not remarked as yet in the colours of the other series. The green is wanting in it.

The second series commences with yellow, then a fine purple, a bright azure, and a fine green.

The third series is composed of yellow, purple, bright azure, very narrow, and scarcely discernible, and then a dull green. This series wants the blue.

The fifth series has only two colours, purple and green, both dull. It entirely wants the yellow.

The sixth series has also only two colours, purple and green, but both dull.

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In the first series, where three or four colours may be distinguished, the yellow and purple increase in intensity, from the exterior to the interior; but the blue and the green decrease in intensity, in the same direction. The oxide of the central spot commences immediately upon the edge of the colour of the last series.

Deductions.—These results shew the strong analogy between the systems of colours produced by heat on metals in contact with the air, and those reflected by thin plates described by Newton. This point admits of farther research, and it is probable the size of the coloured zones or metals will follow the same law of decrement found to obtain with the coloured rings produced by object glasses.

This analogy induces the supposition that, in the combination of oxygen with the surface of the heated plate of metal, a thin pellucid coat of oxide is formed, diminishing in thickness as it recedes from the centre of the heat, as indicated, indeed, by the distribution of the observed colours. This idea leaves nothing mysterious in the appearance of these phenomena, except that belonging to these plates generally, and their manner of producing these particular effects. On this point nothing better than the hypothesis of Newton has, since his time been advanced.

The action of heat is not sufficient to produce these phenomena; the access of oxygen, which may combine with the metal chemically, is required. This may give rise to the query, whether oxygen has not a general influence in the production of such effects. It has certainly been proved that, when a reflection of these colours, in this order, is obtained, that reflection is occasioned by thin plates; but the inverse of this proposition, namely, that whenever thin plates are formed, these colours, in this order, are reflected, has not been proved; and there are, indeed, even arguments to support the contrary; as, for instance, the bubbles of various solutions, which, though very thin and lasting, do not give any appearance of colour.

Giornale di Fisica, II. p. 145.

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2. *Analysis of Mixtures of the Chlorides of Potassium and Sodium.*—This process is founded on the unequal diminution of temperature which these chlorides produce by their solution in water; 50 grammes, (772.2 gr.) of chloride of potassium, when dissolved in 200 grammes (3088.8 gr.) of water, contained in a glass vessel of the capacity of 320 grammes (4942 gr.) of water, and of the weight of 185 grammes (2875.1 gr.,) produce a diminution of 11°.4 centigrade (20.52 Fahrenheit.) The same quantity of chloride of sodium gives, in the same circumstances, a depression of 1°.9, (3.42 Fahrenheit.)

Now, if a mixture of the two chlorides be made, and 50 grammes (772.2 gr.) be dissolved in 200 grammes (3,088.8 gr.) of water, the cold produced will be proportional to the quantities of each of the chlorides; and it is always possible to deduce the one from the other. A table may be made, indicating the diminution of temperature corresponding to known mixtures of the two clorides, but it is sufficient to calculate their proportion by a simple rule of alligation, taking the diminution of temperature produced by the solution of each chloride in water. Making d this diminution, the rule by which to calculate the chloride of potassium in 100 parts of a mixture, with the degree of cold given, is

$$\text{Chloride of potassium} = \frac{100\,d - 190}{9.5}$$

In operating on known mixtures, the proportions calculated by this rule do not differ from the true proportions by more than one-hundredth. The only precautions required for this precision are, 1st, to have a very sensible thermometer, on which the tenths of degrees may be read with ease: 2d, to reduce the mixture to a fine powder, that it may dissolve as rapidly as possible in the water: 3d., to hold the vessel by the neck, only so that the heat of the hand may not influence the temperature of the water. The manner of operating is as follows:—

Having weighed 200 grammes (3088.8 grs.) of water into the glass vase, in which the solution is to be made, the thermometer is to be introduced to ascertain its temperature, which may be supposed 20°.4 (68.72 Fahrenheit;) 50 grammes (772.2 gr.) of the mixture are then quickly introduced, and whilst the

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thermometer is suspended in the liquid by the left hand, the vessel is to be held by its neck in the right, and a rapid whirling motion given to it, to accelerate the solution. Whilst this is doing, the thermometer falls rapidly; it is to be observed with attention, and the lowest degree to which it passes noted. Suppose this 12°.8 (58.04 Fahrenheit.) The diminution of temperature d is consequently 20°.4 — 12°.8 = 7°.6 (13.68 Fahrenheit,) and the chloride of potassium is equal to $\frac{100 \times 7.6 - 190}{9.5} = 60$.

This process, which scarcely requires ten minutes to be completed, is susceptible of the greatest precision, and, in consequence of its simplicity, may readily be employed in the arts. It is especially advantageous in the preparation of nitre, for the analysis of the salts which are deposited during the evaporation of the water, and which are the chlorides of potassium and sodium, in very variable proportions.

Nitre produces also much cold by its solution in water. The means which have been noticed are also applicable to the analysis of a mixture of nitre and common salt. In general, this method may serve for all those bodies which produce very unequal diminutions of temperature by solution in water, or in any other liquid.—*Annales de Chimie.*, XII., p. 42.

3. *Discovery of pyroligneous Acid.*

Mr. Editor,—Sir,—In the *Revue Encyclopédique*, M. le Comte Chaptal has published an article *de l'Industrie Françoise*, in which, among other things, pyroligneous acid is enumerated as being one of the discoveries made in the arts by the French. Whenever priority of discovery is wrongfully claimed, it may be well to point it out, that the merit of originality may be attached to its proper claimant. With this view, I have copied the following statement from a work printed by Cooke, London, in the year 1661, entitled, the *Sceptical Chemist*, in which it appears, that pyroligneous acid is of much earlier origin than is commonly supposed, and that the fact of its forming sugar of lead with minium was known one hundred and fifty-eight years ago.

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Page 194. ——" that the sour spirit of box not only would, as I just now related, dissolve corals, which the other * would not fasten on, but being poured upon salt of tartar, would immediately boil and hiss, whereas the other would lie quietly upon it. The acid spirit poured upon minium made a sugar of lead, which I did not find the other to do."

Page 195. ——" I found, according to my expectation, that the acid spirit had really dissolved the corals, and had coagulated with them. For, by the affusion of fair water, I obtained a solution which (to note that singularity upon the bye) was red; whence the water, being evaporated, there remained a soluble substance, much like the ordinary salt of coral, as chymists are pleased to call that magistery of corals, which they make by dissolving them in common spirit of vinager."

And, in page 192, the " soure spirit" obtained from the distillation of box is expressly called " vinager."

By inserting the above account in the *Journal of Science*, you will oblige, Sir, your humble servant, E. T. J.

Bristol, 16*th Nov.* 1819.

4. *Preparation of Nitric Ether, by* M. Bouillon Lagrange.—After having made a mixture of equal parts of nitric acid at 36° (S.G. 1.333) and alcohol, at 40° (S.G. .817), it is to be introduced into a matrass.

Then copper turnings are to be put into a flask, to which an S tube is to be connected, by which nitric acid may be poured on them, and another tube also to convey the nitrous gas into the mixture of acid and alcohol. A Woolfe's apparatus is to be connected with this flask, the bottles being half filled with a solution of muriate of soda, and placed in a cooling mixture. The joints being luted, I pour nitric acid in small portions on the copper turnings. The gas disengaged is absorbed only in part by the alcohol, and part passes into the vessels at the extremity of the apparatus. The mixture heats gradually, and, at the end of an hour and a half, it begins to boil. The

* The aqueous and oily part procured by distillation, after saturating the acid with coral.

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cooling mixture is then placed round the bottles, and the boiling continues for about half an hour. During this time, nothing but a gas, much etherised, is disengaged at the extremity of the apparatus.

Products.—In the first bottle there was scarcely any ether; the water was green, and had a strong odour.

In the next bottle was the nitric ether perfectly analogous to that described by authors, very volatile, and not acid: eight ounces of alcohol and acid give about three ounces of ether.—*Journal de Pharmacie*, V., 433.

5. *Note on the Animal Substances which generally accompany Uric Acid in Calculi, by* Dr. Gaspare Brugnatelli.—In observing calculi of a yellow colour, which, at first, are considered as being uric acid, it is easy to perceive, that, besides this acid, they contain some other animal matter. This has already been noticed by Fourcroy, Vauquelin, Berzelius, and my father; but, as they have only spoken of it incidentally, there still remains some points of research for the perfect knowledge of these calculi,. I have made a few experiments on these points, and shall state the results in this note.

Two distinct animal substances accompany the uric acid in yellow calculi. These, from the appearances they present, I shall, for the present, call *colorante* (colouring) and *fioccosa* (flocculent). Having obtained the urate of potash, by heating potash in solution with the powder of yellow calculi, and afterwards decomposing it by muriatic acid in excess, so as to separate the uric acid, the fluid part has a green colour, and a disagreeable odour, and the uric acid, separated by a filter, has also a green colour. If the powder of the calculi, which has already been acted on, be again heated with solution of potash, and the urate of potash be decomposed by acid, a much whiter uric acid will be obtained, and the liquid will be less charged with colour; and the residuum which escapes the action of the potash, though often containing much uric acid, is also very white. There is, therefore, in the yellow calculi, a colour-

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ing matter, acted on and dissolved with facility in alkali, and extremely soluble also in acids at a boiling temperature: thus muriatic acid, scarcely raised to the boiling point, on the powder of uric acid calculi, becomes of a dark green colour, and the powder remains of a pale tint. This being converted into urate of potash, and the salt afterwards decomposed, a uric acid is obtained of extreme whiteness, and the liquor is scarcely coloured. The uric acid obtained by the common mode, which is always yellow, even after many washings, becomes extremely white, if treated with boiling muriatic acid. Absence of colour is certainly a character of pure uric acid, and my father has found many calculi of a perfect whiteness, yet, nevertheless, rich in uric acid. (*Litologia Umana.*)

Distilled vinegar becomes yellow when heated with the powder of uric acid calculi. If an urate of lime be formed, and afterwards decomposed by distilled vinegar, a perfectly white uric acid will be obtained.

The other substance which accompanies uric acid may be obtained by saturating the acid muriate of potash, left in the preparation of uric acid, with the sub-carbonate of potash. The green colour becomes of a dirty yellow, and, by degrees, a turbidness takes place, which, after some time, gives rise to extremely white flocculi. The uric acid, which has been obtained, appears also to be contaminated with this matter, as may be proved, if boiled in an acid, and the acid saturated with potash. The substance seems to adhere very strongly to uric acid, and can scarcely have its last portions separated.

Acids, by their direct action on the powder of uric acid calculi, when aided by heat, extract also a portion of this flocculent matter; but it is separated in much greater quantity, when the action of potash precedes. Indeed, if the calculi in powder be treated with boiling acid, until no further portion of the flocculent matter can be separated, and then converted into urate of potash, this urate, decomposed by muriatic acid, gives an acid muriate of potash, which, when saturated, precipitates the white flocculi.

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The flocculent matter, collected on a filter, has, at first, the appearance of gelatine: on drying, it cracks, and may easily be reduced to powder. It is white and insipid, insoluble in potash, dissolving readily in acids, and separated from them by alkalis. Their solution in nitric acid does not occasion any reddening. Acids holding it in solution are tinged greenish blue or light blue by ferro-prussiate of potash; and, after some time, flocculi of the same colour separate; and the fluid remains yellow. If distilled vinegar is used, this effect is but slowly produced.

After what has been said, it must appear singular, that the flocculent matter can form with acids a combination insoluble in acids themselves, but which was ascertained by Berzelius. Having prepared uric acid, and washed it on a filter with muriatic acid, the latter passed in a very turbid state, which, on remaining at rest for some time, deposited a matter, that, when dissolved in hot water and treated with alkali, gave the white flocculi, and the aqueous solution was coloured light blue by ferro-prussiate of potash. The turbid muriatic acid became transparent, and of a bright green colour, when boiled.

It appears, from various indications, that the colouring matter is the same as that which tinges the urine, and the flocculent substance does not seem to differ from that of a similar aspect which is deposited in the same fluid, upon its remaining some time at rest. The yellow colour of uric acid calculi is exactly the same with the yellow tint of urine, and, as a few drops of nitric acid will give the latter a rose tint, so also will they have the same effect on a solution of the above-mentioned substance in the acid muriate of potash. As to the flocculent matter of urine, its solution in acids is also decomposed by alkalis, and it acquires a fine blue tint, when tested by ferro-prussiate of potash.

The following conclusions may be drawn from the above observations. They enable uric acid to be obtained of a great degree of purity, which is done by boiling it in muriatic acid.

They explain why, in the preparation of erithric acid, a liquid is obtained, which, though abounding with the acid,

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refuses to crystallize. An effect which may be ascribed to the flocculent matter remaining dissolved with it.

They account for the blue tint produced by ferro-prussiate of potash in muriatic acid that has been boiled on uric acid, which colouring has been ascribed to many other causes than the true one.

Finally, admitting, with M. Vogel, that the rosacic acid is converted into uric acid by the solvent powers of various acids, we shall perceive in this an effect similar to the preceding; and, if we suppose the coloured and flocculent substances to vary in quantity, as in the intermitting and inflammatory fevers which produce rosacic acid, the colour and the constitution of the urine will, of course, vary also. In the same way, therefore, as variations in the proportions and qualities of extraneous substances render uric acid calculi of a yellow colour more or less deep, or sometimes even red, it will be fair to suppose that the rosacic acid is a combination of animal substances, of which uric acid is the base.—*Giornale di Fisica*, 1. p. 132.

6. *Purpuric Acid.*—Dr. Prout, in answer to what has been said by M. Vauquelin, denying the existence of purpuric acid, has published a brief reply, which carries with it the tone of perfect security; and there is not, perhaps, much doubt that M. Vauquelin will ultimately prove to be wrong. Dr. Prout denies being a repeater of M. Brugnatelli's experiments, and avows his opinion that the erithric acid of M. Brugnatelli is very different to purpuric acid. Dr. Prout directs the formation of erithric acid thus: dissolve pure lithic acid in a slight excess of nitric acid, evaporate the solution slowly, and put it by to crystallize in a warm place: transparent colourless crystals will be speedily formed, having all the properties ascribed to them by M. Brugnatelli. These crystals are also formed when purpuric acid, or purpurate of ammonia, is dissolved in nitric acid, and treated similarly. Dr. Prout is not decided with respect to their composition, but thinks they are either a compound of super-nitrate and super-purpurate of ammonia, or a simple compound of nitric and purpuric acid.

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Dr. Prout admits the principle which M. Vauquelin claims the discovery of, and attributes his want of success in obtaining purpuric acid, to his having used impure lithic acid. Dr. Prout always used pure lithic acid, obtained from the excrements of the serpent exhibited as a boa constrictor. Perhaps the observations published by M. Brugnatelli, of which an account is given at page 370, will assist M. Vauquelin in getting over this difficulty.

7. *On the Decomposition of Chloride of Silver, by Hydrogen, and by Zinc, by* M, Faraday, *Chemical Assistant, &c.*—M. Arfwedson some time ago communicated to me a mode of reducing chloride of silver, by hydrogen (see Vol. 5, page 360.) In a few experiments made some time since, in consequence of this communication, I found myself unable to decompose the chloride by a stream of pure hydrogen gas, or by allowing an atmosphere of the gas to remain for a long time in contact with it; I supposed, therefore, that the effect was produced by the hydrogen, in its nascent state. But lately resuming the experiment, with the intention of ascertaining why the nascent state was more favourable for the combination of the elements, than that of developement, I found reason to suppose that the hydrogen was not at all concerned in liberating the chlorine from the silver.

When zinc is thrown into chloride of silver, diffused through dilute sulphuric or muriatic acid, hydrogen is liberated, and the chloride suffers decomposition. But the same effect takes place if zinc be thrown into chloride of silver, diffused through pure water, so that the hydrogen which escapes in the state of gas, cannot, in its nascent state, have been the decomposing agent. It may however be supposed, that water is decomposed even when no acid is present, and that thus hydrogen is still the agent. But I find that zinc decomposes chloride of silver, even more rapidly when unembarrassed by water, than when water is present. Thus, if a little fused chloride of silver, and a small portion of zinc, be heated in a glass tube, a violent action takes place; chloride of zinc is formed, and silver liberated, and the heat rises so high as generally to fuse the silver; or if dry chloride of silver in powder be triturated in a mortar

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with zinc filings, the two bodies immediately act, and a hea above that of boiling water is produced.

Zinc is not the only common metal which thus rapidly decomposes chloride of silver, in the dry way. Tin acts even more powerfully when triturated with it: and copper and iron have both of them affinities for chlorine strong enough to produce the same effect.

There is therefore no occasion to assume hydrogen as the decomposing agent, when chloride of silver is reduced in contact with zinc or iron (iron acts as zinc does in all these experiments, though not so powerfully); for the metals, by their attraction for chlorine, are sufficiently energetic to produce the effect. Yet, as I had supposed, from general opinion, that hydrogen could, by its attraction for chlorine, separate that element from silver, I endeavoured to ascertain in what circumstances it had the power of doing so. If a stream of hydrogen, rapidly generated from iron or zinc, be sent against moist chloride of silver, in a dark place or by candle-light, it appears to alter it; but this effect must be due to metals or impurities held in solution, for when purified, it has no power of changing it out of day-light; nor have I been able, even in the sun-shine of this month, to make hydrogen act on chloride of silver in several hours.

Still, however, hydrogen may be allowed in certain circumstances to have the power of decomposing chloride of silver, but the circumstances are not such as were, I believe, generally supposed to have place in the experiment first referred to. When zinc, iron, tin, *&c.*, are thrown into moist chloride of silver, the first decomposition is occasioned by the action of the zinc on the chloride, afterwards a voltaic circle is formed by the zinc, the reduced silver and the water; water is decomposed, the zinc takes oxygen, the hydrogen liberated at the surface of the silver takes the chlorine from the chloride in its immediate neighbourhood, and thus the reduction will go on to the distance of an inch or more from the piece of zinc, and the consequent products are silver and solution of muriate of zinc. But as this is a case of decomposition entirely different to the supposed one of the reduction of chloride of silver, by hydrogen, any

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denial of the latter is not at all invalidated by the truth of the former.

8. *On a particular Substance from the Thermal Waters of Ischia.*—Extract from a Letter from Sig. Carlo di Gimbernat, Counsellor of Legation, *&c.*, to Count Moscati, at Milan, dated Naples, Feb. 4, 1819.

" The bottle received with this sheet, contains the substance which is formed by the vapours of the thermal waters of Ischia, and which I discovered last October. It is perfectly identical with that I found at Baden. This substance covers like an integument many rocks in the valleys of Senagalla and Negroponte, at the foot of the famous mountain Epomeo, beneath which the poets confine Typhon; and it is curious to find, exactly in this place, a substance very similar to skin and human flesh *. One part of the mountain, covered with this substance, was found, on measurement, to be forty-five feet long, and twenty-four feet high. The trials I have made to ascertain its nature, gave me, by distillation, an empyreumatic oil; and, by boiling, a gelatine, with which paper might be sized. These results are the same as those I obtained at Baden, and appear to me to characterize its animal nature. The presence, therefore, of an animal principle in thermal waters is confirmed, which being volatilized by heat, is found near the sources in those places where the vapours, by the concurrence of favourable circumstances, are condensed and deposited. This principle I have called Zoogene."

9. *On Gluten, and its Action on Guaiacum.*—The following observations are contained in a Letter from the Marquis Ridolfi to Dr. Brugnatelli:—

* The Editors of the *Giornale di Fisica*, from whence this extract is taken, state, that they have seen the substance obtained by M. Gimbernat, and that they can assure (their readers) that when observed externally, it appears like *true flesh*, covered with skin. They refer also to *Breislak's Voyages, &c.*, where there is an account of a substance, collected by M. Pilhes, from the mineral waters of Aix and Usset, and which was analyzed by Vauquelin. It had many analogies with albumen and mucilaginous matter.—*Giornale di Fisica*, 11. p. 178.

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" D. Taddei, my companion in Natural Philosophy, having undertaken researches in fermentation, and particularly in that of grain and pulse, in various cases has ascertained that the gluten of wheat is composed of two substances, perfectly distinct from each other, one of which he has named *gloiodina*, and the other *zimoma*. The first of these gives to gluten its elasticity; and the second is the cause of the fermentation which takes place in the mixtures of gluten with other vegetable substances. D. Taddei had occasion to mix various gums, gum resins, and resins, with the different kinds of flour. Amongst the mixtures it was found, that that of the powder of the resin of guaiacum with wheat flour, became of a very fine blue, as soon as it was well kneaded with water, in contact with the air. Various colours were produced with the flour of other kinds of grain; and it appeared, that the shade of blue colour, produced by the various mixtures, corresponded to the quantity of *zimoma* contained in them. D. Taddei has made me acquainted with these facts, and whilst he has been engaged on other things, I have pursued them somewhat farther. I have observed that guaiacum does not give any blue colour to pure starch, however mixed with it, nor to any other vegetable substance, not containing *zimoma*; that it is not at all, or very slightly, tinged by flour poor in gluten, and that it is not tinged by that in which the gluten has been much altered. But when guaicum is mixed with pure gluten, or pure *zimoma*, the colour instantly appears, and is a most superb blue. Guaiacum does not, however, become at all coloured by mixture with *zimoma*, unless contact with the oxygen of the air be allowed.

The powder of guaiacum is, therefore, a re-agent, capable of discovering the alteration which flour may have undergone by fermentation in magazines, ships, &c.; and also of ascertaining if it be mixed with the flour of other seeds deficient in gluten. It will also test the purity of starch. The flour of grain is consequently too a test of the purity of the resin guaiacum, which in commerce is almost always adulterated and falsified.—*Giornale di Fisica*, I. p. 168.

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10. *New Vegetable Alkali.*—M. M. Pelletier and Caventon, give the following account, in a note, of a new alkali, discovered in the seeds of the *Veratrum Sabadilla*:—

"Whilst pursuing our researches on those vegetable substances, which have a marked action on the animal system, we were induced to examine the Ciradille, and we found in them a crystallizable alkaline matter, extremely acrimonious. We as yet are only imperfectly acquainted with this substance; but being aware that many chemists are engaged at present in the analyses of vegetable substances, we have thought right to announce this particular principle.

"We have not been so fortunate in the analyses of hemlock, on which we have lately been engaged; this plant has not offered any thing particular. We have not been able to isolate its active principle, which appears extremely fugacious. Some traces of it may be found in the ethereal tincture of hemlock.

11. *Acids of Arsenic.*—The last determination of M. Berzelius, respecting the composition of these acids, is as follows:—

	Arsenic Acid.		Arsenious Acid.	
Arsenic	65.283	100	75.81	100
Oxygen	34.717	53.179	24.19	31.907

The proportions of the oxygen in the two acids being as 5 to 3.

Some other results are as follows:—

Arseniate of lead	100 arsenic acid.
	192.91 oxide of lead.
Sub-arseniate of lead ..	100 arsenic acid.
	296.04 oxide of lead.
Arseniate of barytes ..	100 arsenic acid.
	132.88 barytes.
Sub-arseniate of barytes	100 arsenic acid.
	199.04 barytes.
Arsenite of lead	100 arsenious acid.
	111.17 oxide of lead.

Annales de Chimie xi. 225.

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12. *Oxides of Mercury.*—Mr. Donovan has, in his late experiments on the compounds of mercury, given the following as the only proportions he could obtain of the elements in the two oxides; though the experiments were frequently and carefully repeated:

Black oxide.	Mercury.....	96.04
	Oxygen	3.96
		100.00
Red oxide.	Mercury.....	92.75
	Oxygen	7.25
		100.00

It is observed also, that mercury perhaps presents an exception to the general law, that the second dose of oxygen is retained by a metal with less force than the first. If red oxide of mercury, in grains, be exposed nearly to a red heat, it becomes black; but it is still peroxide, for if immersed in mercury, or water, so as to exclude oxygen, it comes out, when cold, even a brighter red than before. The red oxide bears a much higher heat than the black. When black oxide is exposed to a moderate heat, part is reduced, and part is raised to the state of peroxide; which then bears even a low red heat unaltered. It is true that light renders red oxide black; but this is only in its progress to the metallic state. All these facts appear to support the exception.—*Thom. Annals* xiv. p. 246.

13. *Volatility of Oxide of Lead.*—Dr. Thomson states the volatility of this substance to be such, that it rises in a common red heat. In the conversion of lead into litharge, and the litharge into lead again, by the manufacturer, a loss of about 10 per cent. is suffered from this cause.

14. *New Acetate of Lead.*—Dr. Thomson has published the analysis of a new acetate of lead. It was obtained at the manufactory of Charles Macintosh, esq., in Glasgow, in large flat rhomboidal crystals. The crystals were white and translucent, and consisted of flat rhomboidal prisms, with angles of

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106° and 74°. Each prism was terminated by a dihedral summit formed by two faces proceeding from the narrow faces of the prism, and meeting at an angle of 130°. They did not change by exposure to air. Their taste was sweet, like common acetate of lead. Their specific gravity 2.575. At 60° 100 parts of water dissolved 34.8 of the salt.

When analysed, it gave Acetic acid 22
Protoxide of lead 59
Water 19
100

And Dr. Thomson considers its atomic composition to be five atoms oxide of lead, four atoms acetic acid, and 19 atoms of water.—*Annals* xiv. p. 382.

15. *Purple Colour for Oil-painting.*—His Excellency the Count le Maistre, of St. Petersburg, has, in a letter to Dr. Crichton, described a method of obtaining the above colour, of a fine tint, durable nature, and fit for oil-painting. After noticing the tendency muriate of gold has to form purple coloured compounds, as with the oxide of tin in the purple of Cassius; with gelatine and starch, when mixed and boiled with them; and with the earths, if precipitated with them, and the precipitates heated; the following directions are given as the best for the preparation of the colour. One part of dry muriate of alumina, one part of sulphate of magnesia, four parts of muriate of barytes, and five parts of carbonate of soda, are each pulverized separately. The pounded salts are mixed in a glass mortar, and a little water is added, merely enough to moisten the mixture. Then a diluted solution of gold is added, by little and little, pounding the matter all the time in the mortar, till the whole has acquired a light sulphur yellow tint, and the consistence of cream. The pounding is continued a long time, to produce the decomposition of the salts with as little water as possible. When no more effervescence is perceptible, and when the salts cease to creak under the pestle, a sufficient quantity of water is to be added for their complete solution. This tedious process is essential to unite the oxide of gold with the earths;

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and the whole success of the operation (which is pretty capricious) depends upon it. The precipitate is to be left 24 hours in the mortar, stirring it, from time to time, with a glass rod. It is then to be poured into a saucer, or other similar vessel, and left till the powder subsides. The supernatant liquid is then drawn off with a syphon, and the deposit is dried in the shade, without washing it.

The precipitate when dried, is yellowish white. The muffle in which it is to be baked, ought to be red hot. The powder is put upon a silver, or porcelain plate, of the thickness of one or two lines; and it must be withdrawn from the fire the instant that it acquires its purple colour. If it be left too long exposed to heat, it acquires a tinge of violet. This is occasioned by the salts it still contains; for, after it has been washed, it may be kept red-hot without losing any of its colour, which indeed acquires greater lustre.

These trials, it is observed, were made on a small scale, and may be improved. The colour appears to want intensity, but the mixture of oils, or gum, renders it sufficiently dark. For oil-painting, it must be carefully rubbed with a mixture of drying oil and varnish. The painting is to be begun by a thin transparent coat. A second coat is sufficient to give it all the lustre of which it is susceptible. The under coats ought to be prepared with rough terra de sienna.—*Annals of Philos.* xiv. p. 361.

16. *Economical Mode of Rectifying Spirit of Wine.*—It is well known that water passes with facility through animal membranes, as bladder, whilst alcohol is almost perfectly retained by them. Thus, by closing a bottle of wine by a piece of bladder, instead of a cork, the wine is, after some time, found diminished in quantity, but strengthened in quality. The *Giornale di Fisica* proposes this principle to be adopted in the rectification of spirits, and relates an experiment made by a correspondent. If alcohol of 30° (S.G. ,867) be put into a bladder until it is half full, the orifice closed, and the bladder then exposed to the sun, the air, or the heat of a stove, after a short

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time, the alcohol will be found rectified to 40° (S.G. ,817); and thus may all the water be evaporated, without losing any of the alcohol. If water be added to make up the diminished weight, the alcohol will return to 30°; and this may readily be done by hanging the bladder in a humid place, as a cellar, for the alcohol which was at 40° will then return to 30°. The bladder is, in fact, a filter which allows the passage of the water, but retains the alcohol.

17. *Phosphoric Acid in Vegetables.*—Mr. Barry, who has lately applied evaporation *in vacuo* to the preparation of pharmaceutical extracts, has observed during a comparison of the preparations made in this way with those commonly prepared, "that phosphoric acid, in a soluble state, is to be found in all the extracts. On further extending the investigation, it was ascertained that this acid, besides that portion of it which exists as phosphate of lime, is contained in a vast variety of vegetables." "I may just mention, that all those vegetables which are cultivated, seem to contain phosphoric salt in great abundance."

18. *An hydrated Carbonate of Copper.*—M. M. Colin and Taillefort find that if any of the blue or green carbonates of copper are heated to the temperature of boiling-water, they lose their water, and become brown. Thus rendered anhydrous, it constitutes a body of such good colour as to promise to be useful as a pigment.

19. *Explosion from Fire-damp.*—On Saturday, Oct. 30, three explosions took place in Kell's pit, near Whitehaven, and occasioned the death of twenty out of the twenty-two unfortunate colliers who were working in it. The occurrence was entirely unexpected. The explosion proceeded from a part of the workings where the pillars are removed, and where ventilation was carried on as perfectly as possible. The overlookers and workmen examined daily whether any fire-damp existed in this part of the pit, and had on no occasion perceived any. The workings there were left on Friday evening, as supposed, in perfect safety. The explosion happened in consequence of

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inattention to a rule established in the collieries, that no hewer approach his work without a Davy in proper order. Rendered careless by the fancied absence of all danger, this precaution was neglected, and the gas which had, from some unforeseen circumstance, accumulated during the night, inflamed. The two surviving men, with a little dog, were taken out thirty-six hours after the explosion, from a cavity in the working, to which they had retreated, where the air was rendered so impure, a light would not burn in it. Five others who retreated with them, had not been able to survive the coldness of the place, the badness of the air, deprivation of food, and the other circumstances that surrounded them in this miserable situation.

20. *Brittleness of Glass.*—A method has lately been published of rendering glass less liable to break by sudden changes of temperature within a certain range. It is to be heated in water up to the boiling point, and then allowed to cool slowly. This method, tried experimentally here, has not succeeded in a single instance.

21. *Rotation of Camphor, &c.*—M. Virey has, in the *Journal de Pharmacie*, Mai, 1819, attributed the rotation of small pieces camphor, *&c.* placed on the surface of clean water to the influence of electricity. His principal argument is, that if a point of iron, or other metal, be brought near one of the revolving pieces, its motion is arrested immediately in a remarkable manner. From the circumstances that the particles of some bodies, as camphor, resins, *&c.*, attract each other, whilst others, as gum tragacanth, repel each other, an idea of polarity is entertained and advanced.

22. *Effect of the Sun's rays on Magnetism.*—Colonel Gibbs, in a letter to the Editor of the *American Journal of Sciences*, relative to the influence of light on magnetism and magnets, says, that having kept his magnet in the dark, and lying down, for a long time, he determined its power; he then exposed it to the sun's rays, lying down and remote from the iron support. In forty minutes it gained 12oz. in power, and in

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5 hours 2 oz. more. It is not said how much the magnet would carry, nor if the place where it lay when covered up and when exposed to the sun were the same.

23. *New Electrical Battery.*—Dr. Dana, of Harvard University in America, has constructed an electrical battery of plates, extremely portable and compact, and from his experiments, appearing to be very powerful. It consists of alternate plates of flat glass and tin foil, the glass plates being on all sides two inches larger than those of foil. The alternate plates of tinfoil are connected together, *i. e.* the 1st, 3d, 5th, 7th. &c. on one side, and the other series, or 2nd, 4th, 6th, 8th, &c. on the other side, slips of tinfoil extending from the sheet to the edge of the glass plates, for that purpose. These connexions unite together all the surfaces, which when the battery is charged, take by induction the same state. A battery constructed in this way, contains in the bulk of a 4to volume a very powerful instrument, and when made of plate-glass, it is extremely easy, by varnishing the edges, to keep the whole of the inner surfaces from the air, and to retain it in a constant state of dry insulation.

From the superiority of mica over glass in the thinness of its plates, its toughness, and flexibility, and its greater power of insulation, there is every probability that an admirable instrument might be constructed in this way with it.—*Silliman's Journal*, I. p. 292.

24. *New Woolfe's Apparatus.*—Dr. Hare, of the University of Pennsylvania, has contrived a new apparatus for the impregnation of fluids by gasses, or for other purposes for which Woolfe's apparatus is used. Its convenience consists in being easily taken apart and put together, and, if required, of being constructed in only two pieces, though with several chambers. One part of the apparatus consists of several concentric glass jars, so proportioned in size as to admit of glass receivers between them; these are the various chambers for the water or solution, and the inner ones are more convenient if

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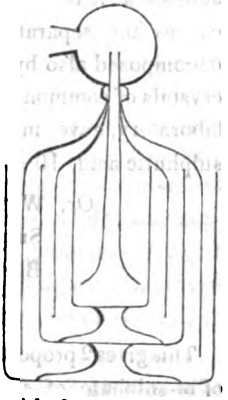
furnished with feet, for then there is more space for the fluid. A series of glass receivers, contracted at top in the usual way, form the other part of the apparatus. Their number and size is to be such, that one will go between each glass jar, and they are to be connected together by the necks air tight, in a way that, when put down among the glass jars, each shall take its proper place; a trumpet-formed tube is to be fixed in the midst of these receivers, its wide termination being destined for the inner jar, and the narrow end to pass upwards through the necks of the receivers, and to form the only aperture through them; on this is fixed globular receiver, to which a retort generating gas or any other apparatus, may be fixed. When used, as for instance in the production of muriatic acid, water is put into the jars, and the receivers dropped down until their edges dip some way into the water, then muriatic acid gas being made to enter above, any impurities it carries over are deposited in the balloon, and the gas passes down the trumpet tube, and is absorbed by the fluid beneath. When that portion of the fluid is saturated, the gas by its pressure depresses the solution, and escaping into the first receiver, gets round the edge of the jar, and comes in contact with the water on its outside in the second jar; it becomes also saturated, and then the gas passes into the second receiver, and so on.



The form and the shape of this apparatus are easily varied, they have been made of porcelain and stone ware, they have also been made square and oblong. Dr. Hare, has found them so effectual as to produce a strong solution of muriatic acid in the central jar, when the fluid in the third and external jar has not been at all acid.—*Silliman's Journal*, Vol. I. p. 410.

25. *New Method of preparing the Purple of Cassius.*—The Count de Maistre says, that placing a sequin in contact with mercury at one of its surfaces, and twenty-four hours after

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fusing it with an equal weight of tin, an alloy was obtained, which was fusible in boiling resin. Afterwards triturating this alloy with pure caustic magnesia in a mortar, a powder was obtained of a very fine purple colour.

26. *Fulminating Gold.*—Count de Maistre also describes a fulminating gold obtained by pouring a small quantity of solution of gold into red wine, (Bordeaux); a sediment formed which, when dried, and placed on burning charcoal in an iron capsule, exploded.

27. *Soda alum.*—An alum, containing soda as its alkaline base, has been sent to the Royal Institution, by Mr. Beatson, who states that it is decomposed, when in solution, by cold, which causes the separation of crystals of sulphate of soda. It is decomposed also by salts of potassium, which separate from it crystals of common alum. A hasty analysis of it, made in the laboratory, gave, in 100 parts of this alum, 51.2 of water, 32.14 sulphuric acid, 10 alumina, and 6.32 of soda;

Or,	Water	51.2
	Sulphate of alumine.....	26.1
	Bi-sulphate of soda	22.4
		99.7

This gives 2 proportionals of sulphate of alumine, 1 proportional of bi-sulphate of soda, and 28 proportionals nearly of water; hence its composition seems to be very analogous to that of common alum, as ascertained by Mr. Phillips.

It crystallizes in octoëdra, which are generally very imperfect. (See *Journal*, page 363, Vol. VI.) M. F.

28. *On the conversion of Ligneous matter into Gum, Sugar, a particular Acid, and Ulmin.*—M. Braconnot's researches on these substances are of extreme importance, from the relation they have to the conversion and formation of the same principles by natural processes. The following is a compressed account of his Memoir, which has just reached this country.

Whilst examining the action of sulphuric acid on wood, 20 grammes (308.9 gr.) of dried elm saw-dust were moistened

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with cold sulphuric acid, of sp. gr. 1.827, and the mixture stirred; it heated, and much sulphurous acid gas was disengaged. The wood became black, and appeared to be charcoal, but was not so in reality. Water was poured on the mixture, and the black powder separated; when dry, it burned with flame. It did not colour cold water, but with boiling water and alkaline solutions gave a deep brown solution. It was nearly in the state which the saw-dust would have acquired by exposure for some years to air and moisture. The nearly colourless acid liquor, after being saturated with carbonate of lime, gave on evaporation, a yellow gummy matter, with a solution of which sub-acetate of lead formed an abundant white magma. The gummy matter, acted on by weak sulphuric acid, gave acetic acid, and a precipitate of sulphate of lime.

The experiment was repeated, with 16 grammes (247.1 gr.) of the saw-dust; but instead of mixing the whole quantity of materials at once, small portions of the wood were triturated at a time, adding the acid by degrees; still sulphurous acid was disengaged, but a very thick tenacious mucilage was obtained. This was diffused in water, and filtered through a cloth; there remained a black insoluble matter, weighing 5 grammes (77.2 gr.) similar to that before-mentioned. The acid liquor, saturated with chalk, and then evaporated, gave 10 grammes (154.5 gr.) of a substance of a reddish brown colour.

As MM. Fourcroy and Vauquelin state, that vegetable substances do not decompose sulphuric acid when cold, M. Braconnot sought some other ligneous substance that would not produce this effect, and ultimately selected hempen cloth; 25 grammes (386.1 gr.) of this cloth, in small pieces, lost on drying 1 gramme (15.5 gr.) of water. It was moistened in a glass mortar, with 34 grammes (525) of sulphuric acid added by portions, and continually stirred with a strong rod of glass, that the acid might penetrate all parts, and that the heat caused by each addition of it, might be dissipated before more acid was added; not the slightest portion of sulphurous acid was disengaged. A quarter of an hour after the mixture was made, it was rubbed in the mortar; the tissue of the cloth disappeared, and a very tenacious mucilage, homogeneous, and little coloured, was obtained

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This was left for twenty-four hours, and was then entirely soluble in water, with the exception of an amylacious matter, weighing, when dry, 2.5 grammes (38.6 gr.). It was a portion of the cloth not perfectly altered by the acid. The diluted acid macilage was saturated with chalk, and filtered through cloth, it was then clear, and of a slight amber colour. After washing the filter well, and pressing strongly the sulphate of lime, all the liquors were united, and evaporated to a syrup, which was less coloured than that of capillaire. A small quantity of sulphate of lime separated on cooling. The evaporation being continued to dryness, a slightly coloured transparent gum was obtained; it weighed 26.2 grammes (404.6 gr.), and was produced from 21.5 grammes (332 gr.) of cloth, abstracting the one gramme of water, and the 2.5 grammes (38.6 gr.) of amylacious ligneous matter. The sulphate of lime also retained a portion of vegetable matter, for it blackened, &c. on being heated. To ascertain whether this increase of weight was due to the fixation of the elements of water, or sulphuric acid, five grammes (77.2 gr.) of the gum were dissolved in water and oxalic acid added to them. The precipitate collected, and strongly heated, gave ,28 grammes (4.3 gr.) of lime. The solution then evaporated to dryness was treated with boiling nitric acid, and diluted with water; nitrate of barytes then gave a precipitate, which, heated red, gave 1.6 grammes (24.7 gr.), equivalent to ,54 grammes (8.34 gr.) of sulphuric acid. As no aeriform matter was disengaged during the action of the acid on the cloth, the 26.2 grammes (404.6 gr.) of gum may be supposed to be thus constituted.

Ligneous matter	21.5
Elements of sulphuric acid fixed in an unknown manner	2.83
Elements of water fixed in an unknown manner	.4
Combined lime	1.47
	26.2 gr.

Hence it appears probable, that the heat evolved during the action of sulphuric acid on vegetable substances is occasioned by the fixation of the elements of the acid and of water.

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When the sulphuric acid was dilated with half its weight of water, it had no action on the linen, cold; but heated, it formed a homogeneous paste, which, mixed with water, resembled boiled starch; farther diluted, it appeared like an emulsion. When observed in the sun, a number of brilliant scales were seen in it, as in a solution of soap. By standing, it deposited a substance resembling starch in appearance, but not having its properties. The liquor separated, gave a very small quantity of gum.

If the cloth be moistened with nitric acid, there is no alteration at common temperatures, but exposed to a hot-water bath until nitrous gas begins to form, it is converted into a white and uniform paste exactly like that obtained by the sulphuric acid. Washed and dried, it had a satin appearance, especially when reduced to powder; if moistened, a slight hissing was heard, and it formed a paste. It is not soluble in potash, and appears to be the ligneous matter of the linen very slightly altered.

The gum obtained by the action of sulphuric acid on linen was purified by precipitating it by sub acetate of lead, and decomposing this compound by sulphuric acid. The liquid was evaporated to a sufficient degree, and the sulphate of lead being separated, the gum was thrown down by alcohol. The sulphuric acid it retained was separated by heating it with oxide of lead, and the small quantity of lead still retained in solution, then separated by sulphuretted hydrogen: the filtered liquor being evaporated, the gum was obtained as pure as possible.

The gum then resembled gum-arabic. It was transparent, of a slight yellow colour, inodorous, insipid, though it reddened tincture of turnsole, and appeared to behave like an acid. The fracture was vitreous. It adhered strongly to the vessels in which it was evaporated, and formed on them a shining kind of varnish. It formed a mucilage less tenacious than that of gum-arabic. Heated, it burnt, giving out a strong odour of sulphurous acid, occasioned by the presence of sulphuric acid in such a state of combination as to be incapable

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of detection by the usual agents. Its residuum contained traces of sulphate of lime. If it be mixed with potash, and heated until partially decomposed, no sulphurous acid is given off, but the residuum being dissolved in water and nitric acid added, a brown flocculent matter precipitates, which is *artificial ulmine*. Nitrate of barytes tests sulphuric acid in this filtered liquor. Red sulphate of iron does not at all affect the gum, though it coagulates abundantly with gum-arabic. Nitric acid, by acting on it, forms a large quantity of oxalic acid in fine crystals, but no mucous acid.

The gum, treated with diluted sulphuric acid, produces two remarkable substances,—sugar, and an acid.

24 grammes (370.6 gr.) of old cloth, well dried, were reduced into gum by 34 grammes (525. gr.) of sulphuric acid, as before described; the acid mixture diluted with water deposited 3.6 grammes (55.5 gr.) of ligneous matter but little altered. The clear fluid, thus diluted, was boiled 10 hours, and then saturated with carbonate of lime. This fluid did not precipitate sub acetate of lead, and contained no gum. It was evaporated, and dried as far as possible, and gave an odour of caromel. It then weighed 23.3 grammes (359.8 gr.) furnished by 20.4 grammes. (315 gr.) of cloth, though there were some losses. This sugary matter was made into a syrup, and, in 24 hours had began to crystallize; in a few days, the whole was a solid mass of crystallized sugar. This was strongly pressed in cloths, and crystallized a second time: it was then moderately pure, but, treated with animal charcoal, it became of extreme whiteness. The crystals were in spherical groups, formed by the union of small diverging plates. They are fusible at 212° Fahrenheit. The sugar has an agreeable taste, and produces a sensation of coolness in the mouth. It dissolves in hot alcohol, and crystallizes by cooling. Dissolved in water, and fermented by a little yeast, it gave a vinous liquor which furnished alcohol by distillation. Burnt with potash, and its charcoal washed with diluted nitric acid, it gave a fluid not troubled by nitrate of barytes. It is evidently identical with the sugar of grapes and of starch.

When the diluted acid mucilage was boiled with oxide of lead

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for a long time, to separate all the sulphuric acid, a peculiar acid was formed at the same time with the sugar above described. This was dissolved out from the evaporated sugar, by rectified alcohol, but as a portion of sugar was also taken up, it was evaporated to a syrup, and agitated with ether. The ether upon evaporation gave an acid nearly colourless, very sharp, almost caustic, and setting the teeth on edge. It was deliquescent and uncrystallizable. It became brown in the air by degrees, if warmed; and, when heated in a capsule, it turned black and began to decompose below the heat of boiling water. If diluted in this state with water, flocculi of carbonized vegetable matter separated, and sulphuric acid was detected in the fluid. If heated above the boiling point of water, its decomposition is very rapid, and much sulphurous acid is disengaged.

This acid does not affect metallic solutions. Nitrate of barytes and sub-acetate of lead are not troubled by it. It acts on carbonates with effervescence. It appears to dissolve all metallic oxides, forming soluble salts, uncrystallizable, deliquescent, and insoluble in rectified alcohol. It dissolves iron and zinc, liberating hydrogen. It forms with barytes and oxide of lead, salts, very soluble, and of a gummy appearance. It will even dissolve a certain quantity of sulphate of lead. It is composed of sulphur, carbon, hydrogen, and oxygen; or, of a vegetable matter and the elements of sulphuric acid, but the state of combination is unknown.

If sulphuric acid be allowed to act on silk for a short time and then the mixture be diluted with water, a mucilage is obtained resembling gum tragacanth. More water being added it precipitates entirely, but a large quantity of hot water dissolves it. If the silk be treated in a mortar with sulphuric acid for 24 hours, a different result is obtained. It is then entirely soluble in water, and when the acid is separated by chalk, and the solution evaporated, a reddish transparent substance is obtained resembling glue, the solution of which is abundantly precipitated by infusion of galls, and sub-acetate of lead.

Gum, treated with sulphuric acid, gave results very nearly the same as cloth. Sugar became darkened by the acid, but de-

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posited no charcoal; the substance obtained from the neutralized solution was of a deep brown colour, and of a sweet bitter taste. It gave, when heated, vapours of sulphurous acid.

M. Braconnot then proceeds to shew that by abstracting the elements of water from wood, it is converted into a substance resembling *ulmin*. Ligneous fibre is not at all soluble in cold potash, but if equal weights of caustic potash and saw-dust, moistened with a little water, be heated in a platinum or iron crucible, and, continually agitated at a certain point, the wood will soften, and instantly dissolve in the alkali, with much swelling. If the crucible be then withdrawn, and put into water, all the mixture will dissolve, except a small earthy residue; and a deep brown fluid will be obtained, containing potash combined with ulmin; an acid will separate the latter, which only requires washing to be pure. If the acid liquor be saturated with lime, and evaporated to dryness, alcohol, when digested on it, will separate acetate of potash. Wood, thus treated, gives a fourth of its weight of ulmin.

Artificial ulmin, when dry, is black as jet; it is very brittle, breaking into angular fragments; its fracture is vitreous, it is nearly insipid and inodorous. When dried, it is insoluble in water, but if just precipitated, it dissolves in small quantities, making a brown solution. It does not contain more than $\frac{1}{2500}$ of ulmin, but it froths on agitation like solution of natural ulmin.

When compared with natural ulmin, from the beech tree, by the action of re-agents, it was very similar to it. It combines with potash readily, and neutralizes it. The combination is very soluble, and is precipitated by acids, earthy and metallic salts, and lime water: this combination may, perhaps, be useful as a colour. It combines with ammonia; it is soluble in concentrated sulphuric acid, but is precipitated by water; it dissolves readily in alcohol, and appears, when slowly evaporated, to crystallize from it. The solution is precipitated by water. When heated, it swells and burns with a little flame.

Such is a brief account of M. Braconnot's paper, but the matter is so excellent, and so free from any thing extraneous, that

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its value should not be estimated until the paper itself has been read, for which, see *Annales de Chimie*, xii. p. 172.

IV. General Literature.

1. *Grecian University.*—An University has been established at Corfu, by Lord Guildford, under the auspices of the British Government. His Lordship has appointed to the different schools Greeks of the first abilities, and his attentions have been seconded with much effect by Count Capo d'Istria, a native of Corfu, who, being apprised that M. Polito, a young Leucadian, possessed of knowledge and talents, desired to profess chemistry in the Ionian islands, remitted to him funds sufficient to procure the apparatus necessary for the laboratory, &c.

2. *Homer's Iliad.*—There has been discovered in the Ambrosian library, at Milan, a manuscript copy of the *Iliad* of Homer, which has attracted the attention of the learned for its antiquity, appearing to border on the fourth century; and, by 60 pictures in it equally ancient. It is more ancient by about six ages than the one on which the editions of Homer are founded. The characters are square capitals, according to the usage of the best ages, without distinction of words, without accents, or the aspirates; that is to say, without any sign of the modern Greek orthography. The pictures are upon vellum, and represent the principal circumstances mentioned in the *Iliad*. These pictures being antique and rare, copies of them have been engraved with the greatest exactness. They are not perfect in the execution, but they possess a certain degree of merit, for they give exact representations of the vestments, the furniture, the usages, the edifices, the arms, the vessels, the sacrifices, the games, the banquets, and the trades of the time, with the precise characters of the gods and heroes, and other numerous marks of their antiquity. M. Angelo Maio, a professor at the Ambrosian College, has caused the manuscript to be printed in one volume, with the engravings from the pictures, and the numerous scholia attached to the manuscript. These new scholia fill more than 36 pages in large folio; they are all of a very antient period, and the

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greater part of them are by authors anterior to the Christian Æra, and to the school of Alexandria. The authors quoted are 140 in number, whose writings have been lost, or are entirely unknown. There are among them titles of works which have not come down to us, and unedited fragments of poets and historians; they quote the most celebrated manuscripts of Homer, such as the two of Aristarchus, those of Antimachus, of Argolichus, the common one, in short, all the best of them; but no authorities are so often quoted as those of Aristarchus, Aristophanes, and Zenodatus, that is to say, the learned men to whom the poems of Homer are indebted for the most ingenious corrections. The manuscript, however, does not contain the *Iliad* entire, but only the fragments which relate to the pictures.

Gent. Mag. lxxxix. 445.

3. *Premium of the Highland Society of London.*—At a late general court of the Society, the following premiums were resolved:—

Twenty guineas, and the medal of the Society, to the author of the best "Essay on the Present State, Character, and Manners, of the Highlanders." The Essay to be delivered to one of the secretaries on or before the 1st of March next.

Twenty guineas, and the medal of the Society to the author of the best "Essay on the Remains of Buildings, and such Monuments as may evince the Degree of Civilization which the ancient Gaelic Scots had attained." The Essay to be given to one of the Secretaries, before March, 1821.

Twenty guineas, and the medal, to the author of the best "Essay on the Etymology of the Gaelic language; its Connexion with other Languages, where it originally existed, and whence derived." The Essay to be given in before the 1st of March, 1822.

Twenty guineas, and the medal, to the author of the best "Essay on the ancient History of the Kingdom of the Gaelic Scots, the Extent of the Country, its Laws, Population, Poetry, and Learning." The Essay to be given in by the 1st of March, 1822.

Twenty guineas, and the medal, to the author of the best

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" Essay on the peculiar Character of the ancient Gael, with their Institutions, and civil and warlike Habits." The Essay to be given in to the secretary, by March 1, 1822.

4. *Cambrian Society in Dyfed. Premiums for* 1820.—A premium of ten pounds for the best " Glossary to the Poems of the Cynfeirdd, or most ancient Bards of Britain, who lived prior to the end of the eighth Century, preceded by an Essay on the Authenticity of the said Poems, on the true Orthography of their Language, and, on the Characteristics of their Fictions."

A premium of ten pounds for the best " Essay on the Origin, Credibility, and authentic Evidences of the Tradition respecting the Chair of Glamorgan, and the political and religious Principles of Bardism."

A premium of ten pounds for the best " Essay on the Evidences and latent Remains of Druidism and Paganism in the Poems of the ancient British Bards."

5. *Prize Question.*—The Royal Society of Sciences at Gottingen has proposed for the subject of a prize to be awarded in November, 1820, " A critical Synopsis of the most ancient Monuments of every Description hitherto discovered in America, to be placed in Comparison with those of Asia, Egypt, *&c.*" The Memoirs to be written in Latin. Value of the prize, fifty ducats.

6. *Antiquities.*—Some time since, in digging, to make gas-tanks at the low lights near North Shields, in a place called Salt Marsh, in Pen Dean, at the distance of 12 feet 6 inches from the surface, the workmen came to a framing of large oak-beams, black as ebony, pinned together with wooden pins, or tree-nails, the whole resembling a wharf, or pier, whither ships, drawing 9 or 10 feet of water, had come. Julius Agricola had his fleet in the Tyne about the 83d year of the Christian æra; and it is supposed he may have moored some of his ships here, though the brook Don, near where Jarrow church now stands, is said to have been his station. The Danes often moored fleets in the Tyne, during their excursions in the ninth, tenth, and eleventh centuries.

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ART. XVIII. METEOROLOGICAL DIARY for the Months of September, October, and November, 1819, kept at EARL SPENCER'S Seat at Althorp, in Northamptonshire. The Thermometer hangs in a North-eastern Aspect, about five feet from the ground, and a foot from the wall.

For September, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Wednesday	1	43	67	29.34	29.48	W	W
Thursday	2	42	65.5	29.50	29.60	W	W
Friday	3	51	71	29.53	29.60	S	W
Saturday	4	48	74	29.77	29.73	SW	SbW
Sunday	5	52	71	29.65	29.70	SW	W
Monday	6	47	70.5	29.78	29.90	SW	SW
Tuesday	7	46.5	73.5	29.90	29.90	SW	WbS
Wednesday	8	49	74.5	29.85	30.00	W	WSW
Thursday	9	61	73.5	30.00	30.00	SE	SW
Friday	10	47	77	30.00	29.97	S	NW
Saturday	11	57	64	29.97	30.00	E	E
Sunday	12	48	68	30.08	30.18	NE	E
Monday	13	37	69	30.18	30.18	SE	SE
Tuesday	14	48	74.5	30.17	30.07	SE	SE
Wednesday	15	46	77	30.03	30.03	SE	SE
Thursday	16	58	57	30.05	30.06	WNW	WbN
Friday	17	43	62	30.06	30.00	NW	W
Saturday	18	46	70	30.00	30.06	W	W
Sunday	19	47	62	30.10	30.10	NW	N
Monday	20	35.5	65.5	30.19	30.27	N	NE
Tuesday	21	35	62	30.34	30.38	NE	ENE
Wednesday	22	34	64	30.37	30.27	E	E
Thursday	23	35	61.5	30.18	29.99	E	ENE
Friday	24	51	61	29.80	29.67	NE	E
Saturday	25	49	61	29.51	29.40	E	W
Sunday	26	45.5	69.5	29.49	29.50	W	SW
Monday	27	48	68.5	29.45	29.44	E	SW
Tuesday	28	44.5	69	29.43	29.46	SW	SW
Wednesday	29	55	62	29.40	29.46	SW	SW
Thursday	30	50	69	29.59	29.62	SW	SW

For October, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Friday	1	56	70	29.59	29.60	SE	SW
Saturday	2	60	72	29.60	29.62	ESE	SE
Sunday	3	54	67	29.58	29.50	S	S
Monday	4	53	60	29.36	29.43	SW	W
Tuesday	5	52	52	29.78	29.96	W	WbN
Wednesday	6	41	57	29.99	30.03	W	W
Thursday	7	38	64.5	29.78	29.72	W	W
Friday	8	53	65	29.55	29.59	W	SW
Saturday	9	56	62.5	29.70	29.68	SW	SE
Sunday	10	56	69	29.82	29.82	SW	SE
Monday	11	53	73	29.79	29.78	SE	SSW
Tuesday	12	48	71.5	29.68	29.60	SW	SE
Wednesday	13	58	67	29.82	29.90	SW	SW
Thursday	14	45	61	29.93	29.98	W	W
Friday	15	45	55.5	29.98	30.02	N	E
Saturday	16	45	55	30.18	30.10	NbE	W
Sunday	17	37	49	30.09	30.12	NW	NW
Monday	18	35	53.5	30.13	30.13	NW	NW
Tuesday	19	37	54	30.03	29.87	NW	W
Wednesday	20	38	51	29.80	29.68	W	W
Thursday	21	38	42	29.68	29.43	NW	NW
Friday	22	37	43	29.35	29.35	NW	WNW
Saturday	23	34	51	29.67	29.82	W	NW
Sunday	24	35	45	29.68	29.35	NW	NNW
Monday	25	30	45	29.28	29.26	NNW	W
Tuesday	26	28	46	29.30	29.60	S	NW
Wednesday	27	44	49	29.68	29.70	NW	NE
Thursday	28	34	42	29.70	29.68	NE	NE
Friday	29	30.5	43.5	29.56	29.46	NE	NE
Saturday	30	37	44	29.56	29.54	NE	NE
Sunday	31	43.3	47.5	29.74	29.80	NE	ENE

For November, 1819.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Monday	1	44	48	29.78	29.68	E	NE
Tuesday	2	37	44	29.61	29.60	NW	WbN
Wednesday	3	34	43	29.70	29.85	W	W
Thursday	4	33	51	29.78	29.72	WbS	WbS
Friday	5	43	51.5	29.54	29.41	WbS	WbS
Saturday	6	40	48	29.36	29.34	W	WbS
Sunday	7	38	42	29.30	29.37	W	W
Monday	8	35	41.5	29.37	29.56	NW	NW
Tuesday	9	37	42	29.72	29.61	WbN	WbS
Wednesday	10	40	45.5	29.63	29.23	SW	N
Thursday	11	41	46	29.56	29.69	NE	NE
Friday	12	38	46	29.86	29.85	NE	NE
Saturday	13	37	44	29.78	29.75	NE	NE
Sunday	14	40	44	29.70	29.70	NW	NW
Monday	15	43	47	29.58	29.56	W	SW
Tuesday	16	40	45	29.42	29.39	W	NW
Wednesday	17	35.5	45.5	29.60	29.75	NE	NE
Thursday	18	35.5	38	29.61	29.63	NE	NE
Friday	19	36	40	29.78	29.78	NE	NE
Saturday	20	36.5	38	29.60	29.38	W	SW
Sunday	21	35	41	29.63	29.49	W	WbN
Monday	22	38	41.5	29.48	29.49	W	W
Tuesday	23	35	34	29.60	29.62	W	W
Wednesday	24	33	35.5	29.71	29.82	W	NW
Thursday	25	32	35.5	29.85	29.80	W	WbN
Friday	26	37	38	29.68	29.81	W	W
Saturday	27	32.5	38	29.73	29.77	W	W
Sunday	28	38	38	29.73	29.61	SW	WbS
Monday	29	34	36	29.41	29.43	SW	SW
Tuesday	30	42	51	29.48	29.49	S	SE

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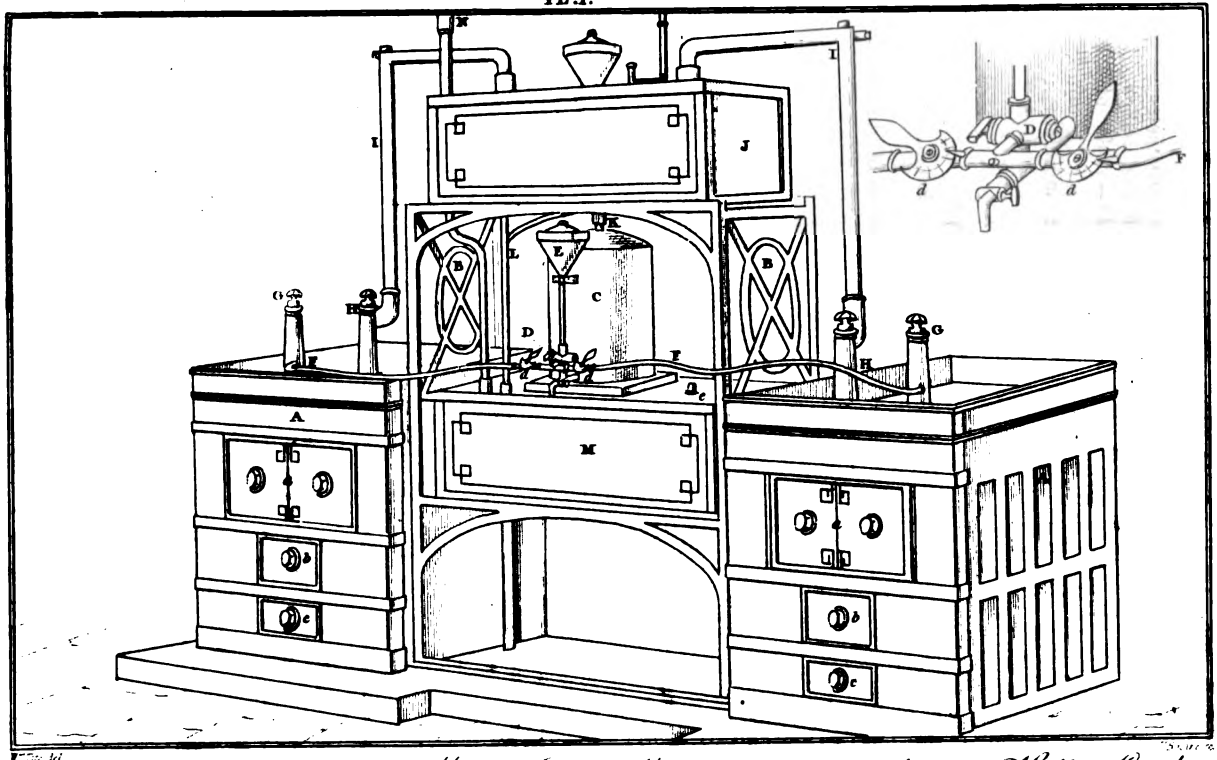

Oil gas Apparatus erected by Mess^rs. Taylors & Martineau, at Apothecaries Hall, London.

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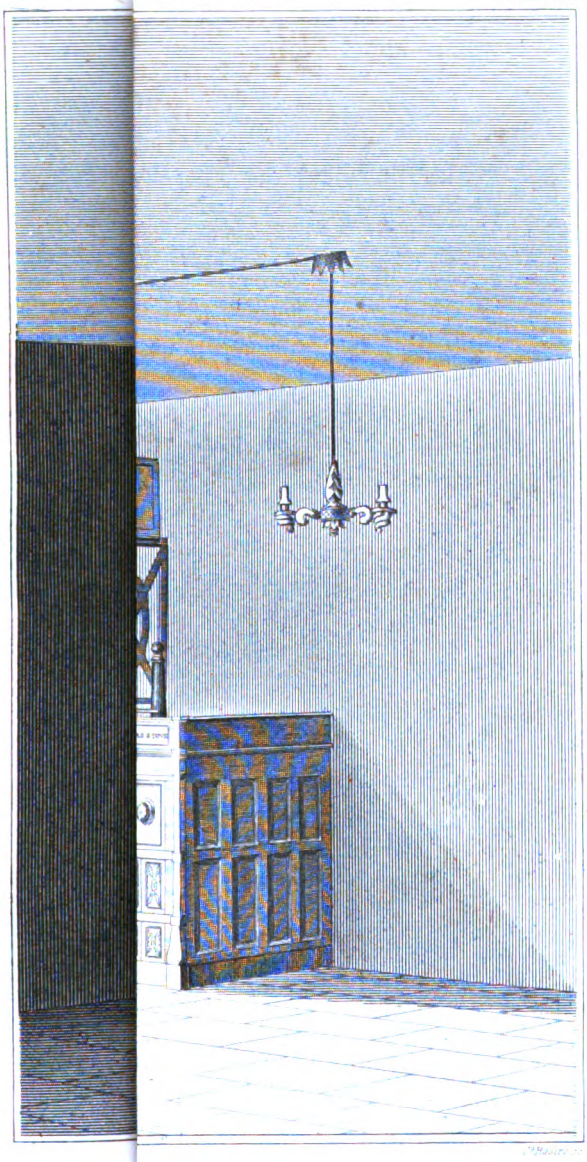

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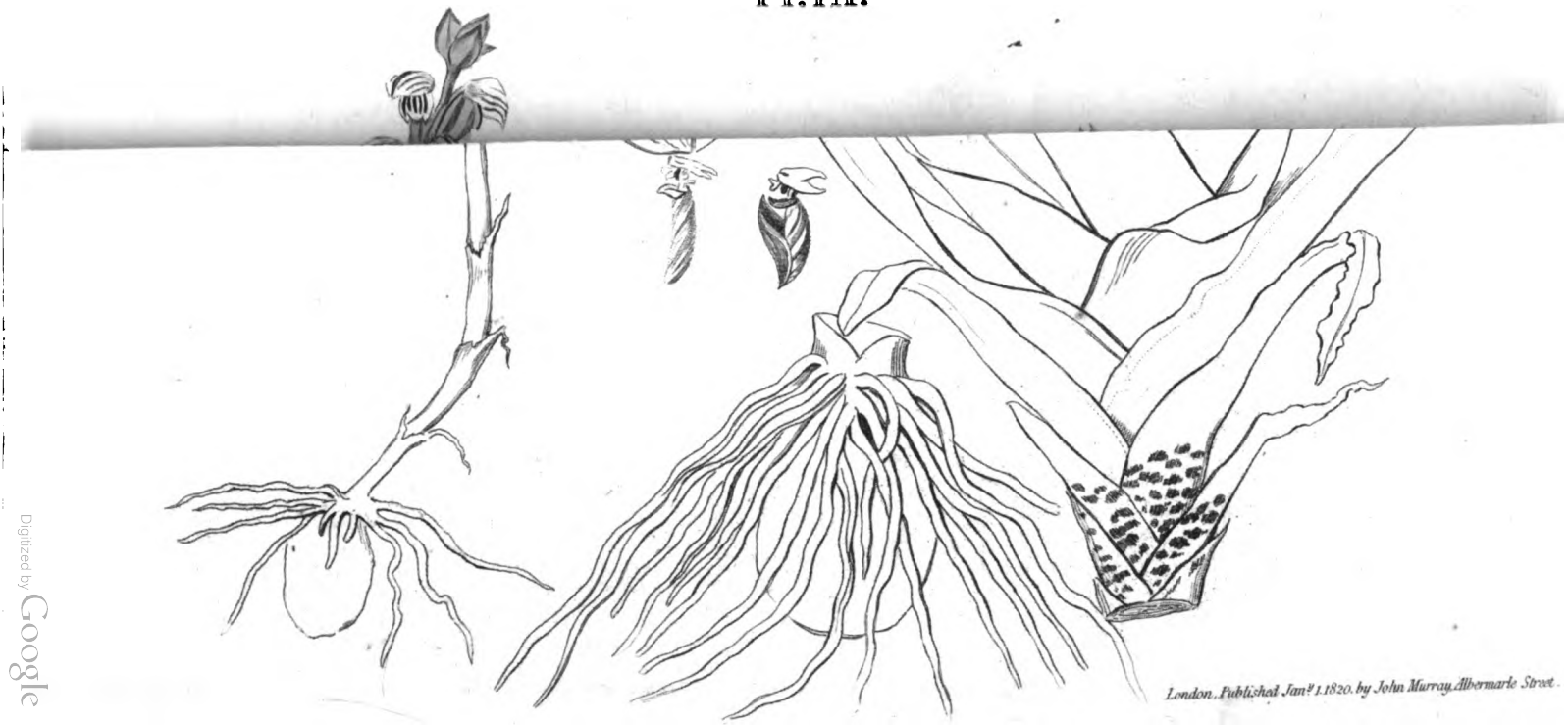

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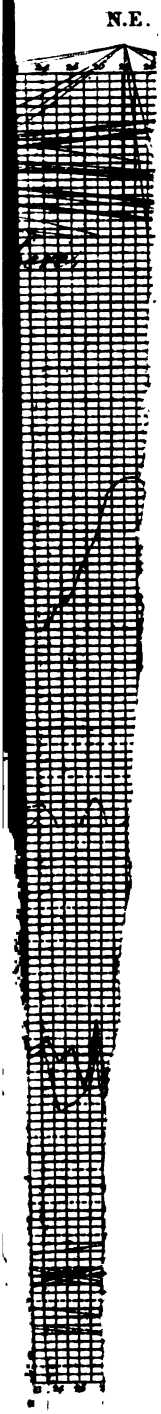

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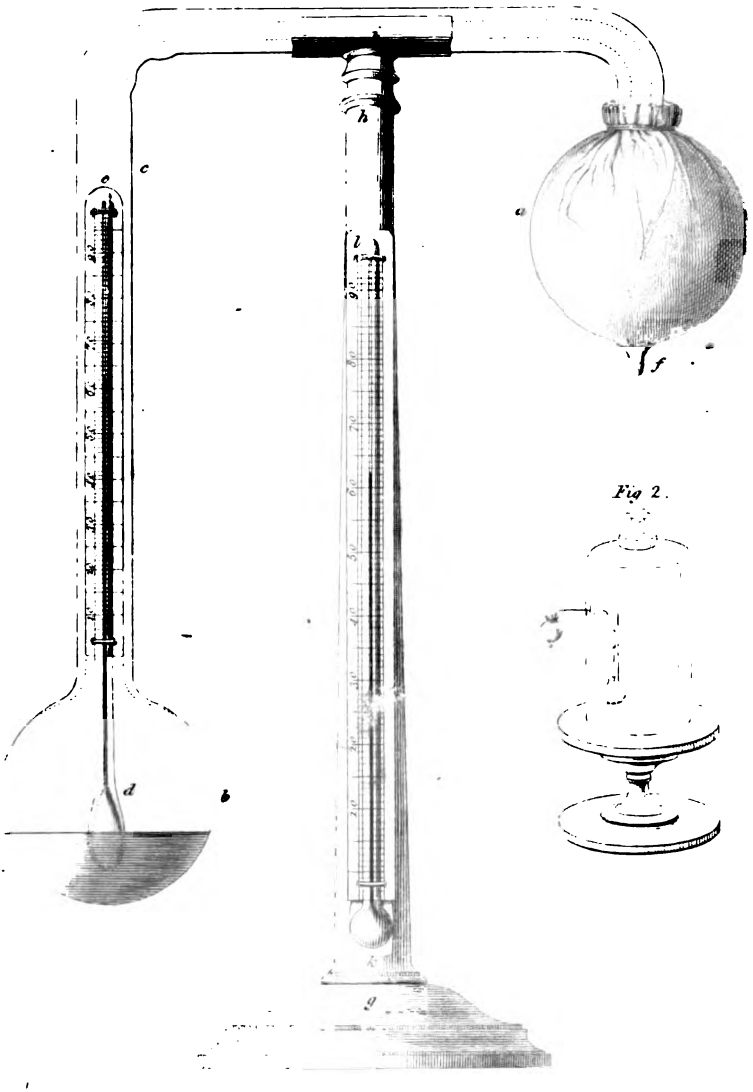

Fig 2.

Mr Daniell's Hygrometer.

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